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ABSTRACT

Intended to introduce young people to the remarkable interconnectedness of people and the environment, this middle school teaching kit is designed to give students an understanding of important population and environmental concepts while promoting a sense of individual responsibility for stewardship of the earth. The teaching modules in the kit touch on issues as immediate as traffic congestion and garbage disposal and as far-reaching as global warming and inequitable resource distribution. The activities are interdisciplinary, developing knowledge and skills applicable to science, mathematics, and social studies. While they are designed primarily for use in grades 6-8, many activities are appropriate for grades 9 and 10 as well. The contents of the kit include: (1) an introductory section called "Meeting the Population Challenge," that includes background information on population growth and its environmental impacts; (2) 17 hands-on activity modules that may be used individually or combined into a larger unit; (3) "Making a Difference," a list of 150 concrete suggestions of things individuals can do in their homes, schools, and communities toward a sustainable balance of population, resources, and environment; (4) "Population Education Resources," a comprehensive listing of further information sources related to population and the environment, including books, bulletins, software, films, and other teaching materials; and (5) "World Population Data Sheet," a wall chart, produced annually by the Population Reference Bureau, that provides demographic data for every country. (JB)

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FOR EARTH'S SAKE

LESSONS IN POPULATION AND THE ENVIRONMENT

SO 020 771

BY DEBORAH E. BROUSE AND PAMELA B. WASSERMAN

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MEETING THE POPULATION CHALLENGE

It is a warm morning in Shanghai, China as 12-year-old Chao makes her way to school. She pedals slowly, so she won't run into one of the thousands of other bicyclists riding down the street. Only one in 2,000 Chinese owns a car. Most, like Chao and her parents, rely on their bicycles to get around the city.

The bell begins to ring as Chao pulls into the schoolyard. She runs to meet her friends, Lee and Vu, with whom she spends a great deal of time. Like Chao, neither Lee nor Vu has any brothers or sisters. Chinese couples who pledge to have only one child receive better homes, jobs, education and health care from the government.

As Chao and her classmates are often reminded, China, like many countries in the world, has had a population explosion in the last century. With over one billion people in 1990, four times the size of the U.S. population, China is unable to provide enough food and fuel for all its people. To solve this population problem, Chinese leaders have ordered the people to have fewer children.

Chao and her friends live in one of the most crowded regions of the world. They are very much aware of the problems caused by overpopulation. China is only one of many countries faced with rapidly growing numbers of people.

Today there are more than five billion people in the world. The population is expected to double in less than 40 years if current growth rates continue. Each year 93 million more people are added to the Earth, more than the entire population of Mexico. The number of people added to the world is equal to another New York City each month, another Houston each week, and another Iceland each day. In the time it takes you to blink your eye, three more people have been added to the planet.

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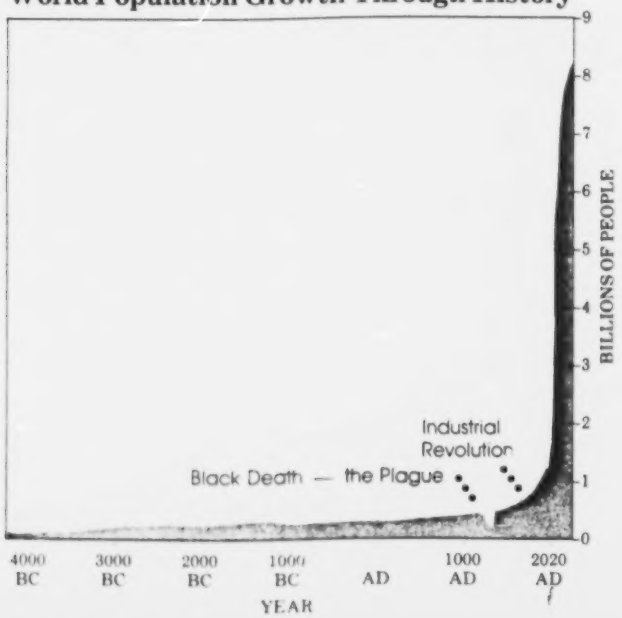
What Caused the Population Explosion?

The population explosion has been very recent in the scope of human history. People lived on Earth for about three million years before the world population reached one billion, in about 1800. Until then, birth rates and death rates were almost the same, keeping the population steady. People had many children, but a vast number of them died before the age of five. Without modern medicine and clean, healthy living conditions, many children did not survive common diseases.

During the late 1700s and 1800s, Europe and North America experienced great changes due to advances in science and technology. This was an era of invention in the Western World. Along with such inventions as the locomotive, telephone and light bulb came advances in farming and medicine, as well as improved sanitation. With better living conditions, more food and new cures for many diseases, people began to live longer. By 1930, the world population reached two billion.

As people in Europe and North America moved to the cities to live and work, families became smaller. It was no longer necessary to have many children to farm the land. In the rest of the world, however, birth rates remained high. Death rates began to drop as new farming methods and medical knowledge were brought over from more developed countries. By the end of World War II, strong medicine like penicillin had been developed to fight off once-deadly infections. In 1960, the world population reached three billion. Just 15 years later, in 1975, the population soared to four billion and topped five billion in 1987. By the end of this century, the Earth will have more than six billion people.

World Population Growth Through History



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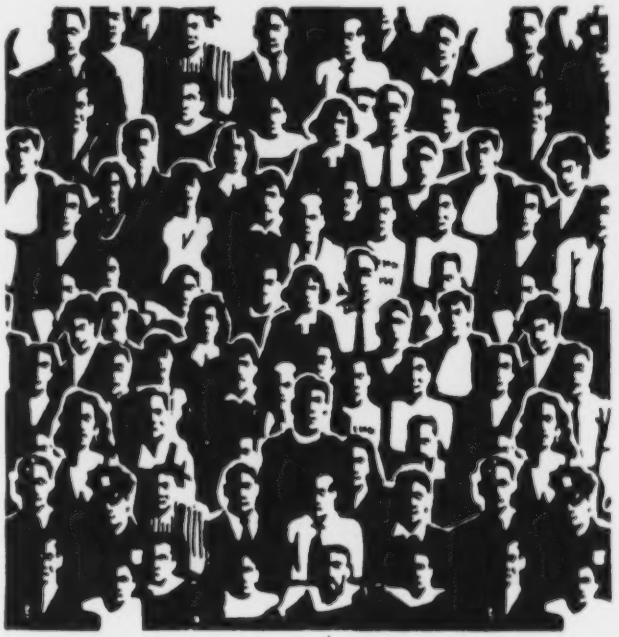

Why Should We Be Concerned About World Population Growth?

Human Suffering

Will we ever reach a point where there are too many people on Earth? Yes. Every environment has a carrying capacity — the point at which there are not enough natural resources (food and fuel) to support any more members of a given species. Think of a pasture where cattle graze. Each animal needs a certain amount of land to have enough grass to eat. If too many animals are added to that same piece of land, there will not be enough food for all. The grass will not grow back fast enough to keep the cattle fed. The same is true for human beings.

Only a small fraction, one-eighth, of all the land in the world is arable (able to be farmed). The rest is built up into cities and towns or is too cold, wet, rocky or dry to grow crops. While the number of people continues to grow, the small portion of land which must support these people remains the same, or becomes smaller as cities expand. Already, one billion people (one-fifth of the world's population) suffer from malnutrition because they do not have enough food to eat.

Loss of Natural Resources

Many countries have tried to grow more food to meet the increasing demand and to save their people from starvation. Each year, 27 to 28 million acres of forests (an area equal to the size of Tennessee) are cut down to create more farmland and obtain wood for fuel and other uses. The loss of these forests affects the entire Earth.

We all depend on these forests, especially the tropical rainforests of Asia, Africa and Latin America, to control the world's weather patterns. We rely on forests to absorb the excess carbon dioxide (CO_2) released from burning fuels in our cars, homes and businesses. Extra carbon dioxide in the air traps more of the sun's heat, not letting it escape back into space. The trapped heat causes the Earth to become gradually warmer like a greenhouse. This abnormal "greenhouse effect" can cause serious climate changes throughout the world, such as droughts in farm areas. Because trees use carbon dioxide as they grow, they help prevent the Earth from becoming too warm. When they absorb CO_2, they produce more oxygen for us to breathe.

With fewer trees, we could lose millions of kinds of plants and animals. We may even find our lives in danger as the warming climate damages food crops and alters the environment in other ways. What's more, tree cover prevents rich soil from wearing away. Much of the forest land which is cleared becomes unusable once this topsoil blows away.

The forest is not the only natural resource affected by overpopulation. Soil, too, is destroyed. In search of food, growing numbers of people have expanded their livestock herds. These billions of animals are now grazing the world's grasslands to dust. Croplands, too, have been destroyed as the rich topsoil blows away after being overworked and misused.

Does the United States Have a Population Problem?

A full 90 percent of population growth occurs in the developing nations of Asia, Africa and Latin America. Still, many developed countries like the United States have growing populations. In fact, the 1990 U.S. population of about 250 million people continues to grow by 2 to 3 million people each year. It is the fastest growing developed country and its population is not expected to level off for another century.

Those of us who live in small towns or farm areas may not feel that the United States greatly contributes to world population problems. In some ways, however, people living in the U.S. are among the most responsible for causing today's key environmental problems. We make up five percent of the population, yet use up more than 20 percent of the Earth's natural resources. Because of this, each American has a much greater impact on the environment than a person from any other country.

Energy Use

For example, let's look at how much energy we use each day. We heat the water for our shower, cook our breakfast, heat or cool our homes, drive to work or school, power the factories that make our clothes and appliances, and so on. Unlike China, where cars are scarce, in the U.S. there is one car for every two people. In one year, the average American uses energy equal to 45 barrels of oil, 15 times as much as the average Chinese.

Aside from using up energy sources at such a fast pace, Americans greatly add to the world's air and water pollution by burning fossil fuels, such as oil and coal. All of the carbon dioxide released from burning these fuels makes the U.S. one of the leading contributors to the "greenhouse effect."

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Trash Production

Have you ever thought about how much trash you produce each day? Where does it go after it's tossed into the garbage truck? On average, each American creates nearly four pounds of trash daily, more than people from any other country. Once the trash reaches the dump, it begins to pile up. Some of it, such as food scraps, decomposes into the ground. However, most of the trash includes plastic and styrofoam containers which do not break down into the soil and can last thousands of years.

As the U.S. population grows, we have more people who create more trash. Already, our dump sites are filling up and we are not able to build new ones fast enough to dispose of all of our waste. Besides, no one really wants new dump sites to be built close to his or her neighborhood.

Not all of our trash can simply be sent to a dump. Much of the waste we create, especially in industry, contains poisonous chemicals. When we dispose of this hazardous waste in the ground, it can leak into our water supply and pollute our drinking water. If it is released into our oceans and rivers, it kills fish and other wildlife. So far, we have not found ways to get rid of this poisonous waste safely. The number of hazardous waste sites grows as the population grows, yet we continue to develop the land around us with more homes and factories.

When we examine the environmental problems in the U.S., it becomes clear that Americans should be concerned about population growth here and throughout the world. The Earth's changes brought on by overpopulation are already being seen. Unless people worldwide act now to protect the health of our planet, we will not be able to promise our children and future generations a good quality of life.

How Can One Person Make a Difference?

Although the problems caused by overpopulation may seem enormous, there are a number of things each of us can do to help solve them. Here are just a few suggestions of what one person can do.

Smaller families

Because each person makes a big impact on the environment, we each need to make careful decisions about the size of the next generation, beginning with the size of our own families. If each couple has more than two children, the population would grow. Those who know they want large families might consider adopting children who have already been born, rather than having more of their own.

Resource conservation

In the United States, we must be aware of the quantity of resources each of us uses, as well as how many of us are using them. In our homes and schools, we can conserve energy by turning off lights and appliances when we are not using them. We can recycle many resources, such as newspapers, cans and bottles instead of throwing them away. Many schools and communities have recycling programs where people can sort their trash so that reusable materials can be made into new items. If there are no recycling programs in your area, perhaps your class can start one.

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Being a smart consumer
Making choices for a healthier environment may start in the grocery store. Try to select foods without a lot of packaging, especially plastic packaging. Also, ask for paper bags instead of plastic ones, since most plastic does not decompose in trash dumps.

Educating others
Now that you know about overpopulation and its effects on the environment, spread the word. Talk to your family and friends about what you've discussed in class. Set up classroom displays or library exhibits for your school's open house night. Talk to your neighbors about recycling trash on your block.

These are only a few suggestions of what we can each do to make a difference in preserving the health and beauty of our planet.

DISCUSSION QUESTIONS:

What Caused the Population Explosion?

1. What trends in society over the last 200 years have led to the population explosion?
2. Why might the rate of population growth be higher in developing countries than in developed countries?

Why Should We Be Concerned About World Population Growth?

1. What are three impacts of world population growth that are causes of concern?
2. How does population growth contribute to the "greenhouse effect"?

Does the United States Have a Population Problem?

1. How do American lifestyles contribute to global environmental problems? Name two ways.
2. Why does each person added to the U.S. population have a greater impact on the environment than an additional person in any other country?

How Can One Person Make a Difference?

1. How can you conserve energy and other resources in your day-to-day activities? Name three possible ways.
2. What are some long-term things you can do to help restore a balance of population and the environment?

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Glossary of Terms

arable—*adj.* Describes land which is suitable for farming.

birth rate—*n.* The number of births per 1,000 people for a given year.

carbon dioxide—*n.* A heavy, colorless gas formed by the burning or decay of organic substances. It is absorbed from the air by plants.

carrying capacity—*n.* The population of a species that an area will support without undergoing decay.

death rate—*n.* The number of deaths per 1,000 people for a given year.

decompose—*v.* To break down into separate parts through chemical change.

developed countries—*n.* Countries where the people's basic needs for food, clean water, health care, etc. are easily met. In general, these are countries which have the most industry. Usually included in this group are the United States, Canada, Japan, Australia, New Zealand, and nearly all the nations of Europe.

developing countries—*n.* Countries where the basic necessities of life are not always easy to obtain and where many of the people face a daily struggle to survive. This region includes Africa, Latin America and most of Asia.

fossil fuels—*n.* Fuels such as coal, oil and natural gas which are extracted from the ground.

hazardous waste—*n.* Trash containing poisonous chemicals.

malnutrition—*n.* Condition where a human or animal lacks necessary amounts and types of nourishing food to live a healthy life.

natural resources—*n.* Industrial materials and capacities (like mineral deposits and waterpower) supplied by nature.

sanitation—*n.* The promotion of cleanliness and prevention of diseases by washing or by the safe disposal of waste and sewage.

tropical rainforests—*n.* Tropical woodland with an annual rainfall of at least 100 inches. Found in Asia, Africa and Latin America, tropical rainforests are home to hundreds of thousands of plant and animal species.

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MAKING A DIFFERENCE

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Achieving a balance of resources, population and the environment is a major challenge, but there are many ways each person can help to make it happen. Here are 150 specific things you can do "for Earth's sake." Some of these suggestions may not be appropriate for everyone, but each person is sure to find plenty of useful ideas here.

Cleaning up the Air and Combating Ozone Layer Depletion

The chlorofluorocarbons (CFCs) used in air conditioners, refrigerators, fire extinguishers, and polystyrene foam products are eating away at the fragile ozone layer of the Earth's atmosphere. The ozone protects us from the sun's harmful rays. Without it, we may experience an increased rate of skin cancer, global climate changes leading to water shortages and crop damage, and disruption of the marine food chain. We must reduce our use of CFC products and reduce the amount of toxic gases we put into the air to maintain a clean oxygen supply and a strong ozone layer.

1. Don't use leaded gas when your car is meant for unleaded. It pumps lead and nitrogen oxides into the atmosphere which contribute to smog, acid rain, and depletion of the ozone layer.
2. Replace hoses in automobile air conditioners to prevent leaks. Make sure air conditioners are serviced or recharged at licensed service stations, preferably those stations that use refrigerant reclaiming systems. Otherwise, ask the station to drain the refrigerant into bottles to prevent it from evaporating.
3. Stomp on or swat bugs instead of spraying, or, better yet, scoop them up and return them to their natural habitat outdoors.
4. Ask your service station to use CFC-recovery equipment when repairing or disposing of auto air conditioners.
5. Avoid cigarette smoke, which contains toxic fumes.
6. Check that your gas stove has adequate ventilation.
7. Repair smoky fireplaces so they draw efficiently.
8. Test your home for radon, especially if you live on the East Coast. Also test for formaldehyde gas found in products such as chipboard, plywood, insulation, carpet and upholstery.
9. Encourage hospitals to stop using CFC sterilants.
10. Plant trees and shrubs in your yard; they absorb carbon dioxide and make oxygen. If planted around the home, particularly on the west side, they can reduce cooling and heating costs.
11. Avoid buying wood from the tropical rainforests (e.g., teak, mahogany) unless you are sure that it was propagated by sustainable tree-farming methods. The rainforests absorb carbon dioxide and provide clean oxygen to help keep the climate steady and cool. They are also home for thousands of plant and animal species.
12. Fill your home, classroom, garden or window sill with plants to help absorb carbon dioxide and cleanse the oxygen supply.
13. Request your local government to set up a system for collecting and recycling the chlorofluorocarbons in old refrigerators and air conditioners.

Preserving Clean Water

In the United States, over 40% of the groundwater (which serves as drinking water for over half the population) is contaminated by industrial and agricultural pollution, waste disposal into the ground, and chemical wastes from mining and petroleum production. After contamination, it is extremely difficult and costly to purify the groundwater. We are rapidly losing one of our most precious resources, but there are many ways we can help preserve our underground water supply.

14. Take showers instead of baths to reduce overall water consumption.

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15. When showering, shaving, brushing teeth or hand-washing clothes, do not let water run when it is not being used.
16. Use ultra-low-flush or air-assisted toilets, which use 60-90% less water, or composting toilets, which use no water and recycle the organic waste.
17. Use water-efficient washing machines and dishwashers and run them only when full.
18. Be sure to fix leaky faucets immediately; promptly replace rubber washers on leaky valves. A little drip can lead to gallons of water wasted every day.
19. Purchase plain, white toilet paper and paper towels because the dyed brands pollute the water when disposed of.
20. Ask your car wash if they recycle their water. If they don't, washing your own car will use less. Be sure to shut off the hose when soaping the car.
21. Shave or use reusable hot wax for hair removal instead of using chemical depilatories which are flushed into the drinking water.
22. Use liquid laundry soaps instead of powders, as the former do not contain phosphates. Use chlorine bleach sparingly or switch to a non-chlorine bleach.
23. Many brands of toothpaste contain cadmium (which becomes harmful as large quantities of it are released into the groundwater) but manufacturers are not required by the FDA to list it among the active ingredients. Write to the maker of your brand and ask whether cadmium is present in your toothpaste. If so, express your concern to the manufacturer and switch brands, or use baking soda instead to clean your teeth.
24. Take used batteries directly to the appropriate disposal site, since the lead and sulfuric acid could otherwise leak into the ground.
25. Water your lawn only if the grass doesn't spring back when stepped on. Use a timer and efficient equipment and water only at night.
26. When you change your oil, do not pour it down the city sewer system. One quart of oil can contaminate up to two million gallons of drinking water. Contact your local sanitation or public works department to find out where your used oil can be recycled or safely disposed of.
27. Use "grey water" (i.e., previously used, like dishwater or pet's drinking water) or rain water for plants and garden, or use an underground drip irrigation system in the garden to send water directly to the roots without evaporation or wastage.
28. Install sink faucet aerators and water-efficient shower heads. These use 2-5 times less water and do not noticeably decrease performance.
29. Visit a nursery to learn about plants native to your environment or climate that require little or no watering.
30. Sweep your sidewalk, driveway or patio instead of hosing it down.
31. Use the correct amount of fertilizer, pesticide and herbicide to prevent pollution. Reduce runoff with good grass cover, shrubs and trees. Look for products that do not have a fossil fuel base.
32. Better yet, use compost instead of chemical fertilizers and contact your county's Cooperative Extension Service to find out about non-polluting alternatives to chemical pesticides and herbicides.

Reducing Solid and Toxic Wastes

The average person in the United States generates about 3.5 pounds of trash per day, which adds up to nearly one ton of trash per person every year. More than half of this waste can be economically recycled. Recycling means we use less landfill space and fewer natural resources such as fuel, water, forests and minerals.

33. Find out where the nearest recycling center or pick-up spot is for glass, aluminum, newspaper, office paper and cardboard. Also ask if they recycle plastic, batteries, motor oil or appliances. Start recycling goods in the home, at the office, in school; organize your own recycling center if necessary.
34. Buy products that are recycled, recyclable, refillable, reliable, repairable and/or reusable.
35. Ask for recycled paper at stationers and printers.
36. Recycle or reuse motor oil, tires and scrap metal.
37. Use mugs instead of paper cups or paper instead of styrofoam, rags instead of paper towels, cloth instead of paper napkins.
38. Convert items for other uses. Try out some of those "household hints" or come up with your own for those used boxes, coffee cans, magazines, etc.
39. Donate used clothing, books, appliances, etc. to local thrift shops or organizations.
40. Organize a book coop in your school or university to resell texts from the previous year to other students.
41. Buy used or antique furniture which you can refinish or reupholster.
42. Buy used or vintage clothing (you can find name brands and new garments in thrift shops, too), or liven up your older clothing with patches, dying, or alterations.
43. Don't just recycle the obvious candidates. You can recycle little cardboard gift boxes, tissue and laundry detergent boxes, glass jelly or mustard jars, ketchup bottles, or aluminum vegetable cans. Be creative and aware!
44. Carry a clean fork, knife, spoon and straw in your purse or briefcase so you won't pick up and throw

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away more plastic ones when you stop for a snack.

45. Buy used appliances, televisions and stereos and repair them, if necessary; you'll probably save money, too.
46. Share and reuse supplies in the office. Pass memos and files around instead of making one for each staff member. Make double-sided photocopies.
47. Save margarine tubs, styrofoam trays, juice cans, toilet paper and paper towel rolls, etc. for children's arts and crafts or simple science projects at a nearby school or camp. Encourage teachers to reuse household supplies in the classroom as well.
48. When putting things into storage, gather free used boxes, jars, and other containers from a local supermarket, your neighbors and your friends instead of buying new supplies.
49. Get heels and holes repaired on your shoes and give them a new polishing instead of buying a new pair.
50. Bring your own bags from home or ask for paper bags, not plastic, at the supermarket. Reuse the supermarket bags in your trash cans instead of buying specially-made plastic ones.
51. Make a compost pile in your backyard. Use old bits of food combined with soil as fertilizer for indoor and outdoor plants. Organize a neighborhood compost program.
52. Avoid buying items made from plastic because it does not biodegrade. For instance, the baskets, shelves, trash cans, file holders, pencil dispensers, etc. in your office can all be bought made out of metal or paper rather than plastic.
53. Buy products in bulk or with the least amount of packaging. It's usually more economical, too.
54. Avoid purchasing packages of disposable goods such as razors or pens. Get one quality item that will last you a long time, and try not to lose it!
55. Always choose paper, glass or metal over plastic packaging for all sorts of products: peanut butter, milk, eggs, ice cream, preserves, sauces, etc.
56. Buy compact discs or cassette tapes instead of record albums. They last longer and use less vinyl.
57. Use cloth diapers on your baby and encourage others to do so as well. Plastic, disposable diapers are enormous contributors to the solid waste crisis since they do not biodegrade.
58. Express your disapproval of waste incinerators to local officials, the media, etc.
59. Buy only what you need and fully use what you buy.
60. Never, ever litter and don't let anyone around you get away with it either.
61. Buy products from companies that don't pollute or damage the environment.
62. Buy rechargeable batteries for flashlights, cassette recorders, etc. They cost a bit more but last much longer.
63. In your home, opt for hardwood floors or ceramic tile instead of wall-to-wall carpeting, or choose carpets made of all-natural fibers.
64. Try non-toxic alternatives to everyday household chemicals:
    1) Instead of oven cleaner, use salt and baking soda.
    2) Replace an ammonia-based cleaner with vinegar, salt and water (add baking soda for the bathroom).
    3) Use half a lemon dipped in non-chlorine powder bleach as an abrasive cleanser.
    4) One part lemon juice with two parts olive or vegetable oil serves as a floor or furniture polish.
    5) Gradually add brewer's yeast to your pet's diet and eliminate flea collars and sprays.
    6) Kill roaches by leaving a mixture of sugar and baking soda in little piles wherever they are spotted.
65. If you must use chemical products in the home (this includes paints, insecticides, cleansers, disinfectants, etc.), be sure to take the unused portions to a household hazardous waste center. To find one near you, call your local sanitation or public works department.
66. Set up a monthly neighborhood toxic chemical disposal effort and transport waste to the appropriate disposal site.
67. Avoid purchasing clothes that require dry cleaning, because the process uses toxic chlorinated solvents. Dry clean only when necessary.
68. Avoid synthetic fibers like polyester. These do not easily biodegrade and may produce hazardous gases when brought in contact with household chemicals.
69. Contact your elected representatives to recommend mandatory household hazardous waste collection.
70. Write or petition local companies to reduce their use and production of toxic chemicals and wastes.
71. Support legislative initiatives that encourage industry to modify manufacturing processes to eliminate the production of hazardous wastes and reduce, reuse and recycle what is produced.

Stabilizing the Population

At the current rate of growth, the world population—already at over 5 billion—is expected to double within

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the next 39 years. The U.S. is the fastest growing industrialized country, and although it makes up only 5% of the world's population, it uses 25% of its resources. The Earth cannot sustain the environmental stress at this rate of growth. Therefore, we must change our population patterns to provide a healthy environment for future generations.

72. Becoming a parent involves many lifelong responsibilities. Take the time to discuss family size with your spouse and plan your family accordingly. Postpone having children until you have been married or in a stable relationship for at least three years. This makes sense for both family stability and population stability.

73. The surest way to avoid unwanted pregnancies is to abstain from sexual activity. When you are ready to become involved in an intimate relationship, consult your doctor, a clinic, or a school nurse about different types of contraceptives, their effectiveness, and the method best suited for you.

74. Promote sex education and population education in nearby schools.

75. Talk to teachers of life science, social studies, mathematics, home economics and family life courses about the possibility of teaching a unit on the population problem. Suggest books, articles and teaching kits you may have come across as supplementary materials.

76. Support and respect the decisions of relatives, friends and acquaintances who choose to have 0, 1 or 2 children or who choose to adopt. In our society, there is a great deal of pressure to have children, and those who opt for small families deserve support.

77. Arrange to have a speaker address your club or community group on the subject of population growth and its impacts on the environment, economy and society.

78. Support contraceptive research and encourage friends and relatives to remain up-to-date on the latest methods of birth control.

79. Consider adopting children in need of homes or becoming a foster parent rather than giving birth to (more) children.

80. Join Zero Population Growth and other organizations that work to ensure a healthier, more stable environment through curbing population growth.

81. Work with a daycare center, summer camp, school, big-brother/sister program or abused children's program to be around children on a regular basis and have an influence on their lives, instead of having (more) children of your own. You might also want to babysit, become a nanny, or "borrow" your friends' children for an evening or weekend; they'll be sure to appreciate the vacation.

82. Promote the inclusion of population issues whenever regional and global planning are discussed.

83. Urge legislators to support assistance for world and U.S. population programs and contraceptive research.

Reducing the Use of Fossil Fuels and Combating Global Warming

Americans are currently very dependent on oil, coal and natural gas. These fuel sources are nonrenewable and burning them pumps toxic gases into our atmosphere. In addition to causing air and water pollution, burning fossil fuels also contributes to global warming. Reducing the use of fossil fuels will reduce the amount of carbon dioxide released into the atmosphere. However, alternatives to these resources that we have come to rely on so heavily are few, expensive, and sometimes—as in the case of nuclear energy—risky. Therefore, it is necessary to use energy as efficiently as possible, which can reduce household requirements from 25% to 90%.

Conserving Energy in the Car:

84. Make sure that energy and environmental issues are covered in your school's driver education courses.

85. Carpool, ride a bicycle or use mass transit whenever possible. Walk for short trips!

86. Drive an energy-efficient car, use radial tires, obey the speed limit and have regular tune-ups and emission checks. Keep tires fully inflated and use high efficiency oil.

87. Engage in non-motorized sports and don't patronize sports such as auto racing, tractor pulls, etc.

88. Make sure you have very clear directions when traveling so you don't end up driving around the block—or the city— three or four times.

89. Change your buying habits—don't drive to the store for just a couple of items.

Conserving Energy in the Home:

90. Save electricity by having a romantic dinner by candlelight or reading a book under a desk lamp instead of an overhead fixture. Open curtains and blinds in the room you are in to let in the daylight, and don't turn on overhead lights until the sun sets.

91. Learn about solar energy use in the home and support other efforts to tap into this natural and unlimited resource. You can build a solar hot water heater to supplement your hot water system or install solar panels on your roof to heat your home for almost no cost.

92. Use solar photovoltaic cells to run yard lights.

93. Wrap your hot water heater in a blanket and lower the temperature to 120 degrees. Use a booster converter for when you need it especially hot.

94. Use solar-powered calculators and rechargeable flashlights and batteries.

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95. Make sure that lights, televisions, radios, etc. are OFF when not in use. Get a timer to turn lights on and off when away on vacation instead of leaving them on all the time.

96. In the winter, put on an extra sweater or some long underwear and turn the thermostat down a few degrees. In the summer, use fans instead of air conditioners whenever possible.

97. Replace incandescent light bulbs with compact fluorescent ones; they use less than one-quarter of the wattage and last ten times as long.

98. Use high-efficiency electrical appliances.

99. Make sure your home is very well insulated. Invest in storm windows or the new "super windows," weather stripping and ample caulking.

100. Turn off your heat, water heater and pilot lights when away on vacation.

101. Conduct an energy-efficiency survey of your home, school or office. You can get a low-cost home energy audit from your utility company. Implement an energy-efficiency program in your house.

102. Use a clothesline instead of a clothes dryer whenever possible. You can rig up a clothesline indoors for when the weather is poor.

103. Close off and do not cool or heat unused rooms. Use shades and curtains to insulate in both summer and winter.

Eating Wisely for the World's Good Health

When we eat foods that are high on the food chain, such as meat and poultry, we are consuming excessive amounts of pesticides and natural resources. In the United States alone, animals raised for food consume enough grain to feed one billion people, about four times the country's population. Animal agriculture is also a prime contributor to topsoil loss, deforestation, water consumption and groundwater contamination through manure fertilizers. Raising livestock as a food source also uses 25 times as much fossil fuel as producing the same amount of protein in grain. By becoming conscientious about what we eat, Americans can help to make a difference in the world hunger problem and further protect our environment.

104. Eat lower on the food chain; that is to say, choose vegetables and grains over meats.

105. Avoid eating junk food that is processed with resources and energy that could be used to provide nutritious foods.

106. Speak to cafeteria personnel in your school or workplace about the advantages of serving foods that are low on the food chain and arranging energy efficient menus.

107. Prepare one meat-free meal a week for your family. You might even try to convert to vegetarianism all together.

108. Invite a speaker, perhaps a refugee, to your school, community center or civic group meeting to discuss the causes of nutrition and malnutrition in the U.S. as compared to some developing countries.

109. Begin a health food snack bar at your school or workplace.

110. Discuss with your family the trade-offs between convenience food menus and fresh food menus.

111. Support development of seed exchanges and home gardening with heirloom varieties of seeds to maintain genetic diversity.

112. Grow your own food garden instead of a lawn. You'll save the water and energy that goes into processing and shipment, and you'll be guaranteed pesticide-free produce.

113. Avoid buying highly processed goods.

114. Buy local produce and other goods. This cuts down on the energy used for packaging and transportation.

115. Join a local food coop or volunteer your time there.

116. Grow produce to give away to local soup kitchens or others who can use it.

117. Fast for a meal or two and donate the money you saved to a local food relief agency.

Becoming Informed and Educating Others

Before we can do anything to help protect our environment, we must understand exactly what it is we are doing to harm it. Each person can help by becoming informed and teaching others about population and environmental problems and their solutions.

118. Learn and study about environmental and population issues to keep well informed and able to defend your position. Look in your local library for recent literature, check magazines, and contact organizations.

119. Hold a nutrition (population, ozone, recycling . . .) education day at your local school, university or church.

120. Invite a farmer or agriculture specialist to your school or community center to discuss the effects of different farming and irrigation methods and the effects of pesticide and fertilizer runoff.

121. Write articles about the environment and population growth for your school or town newspaper or design a bulletin board or library display to help educate others.

122. Attend lectures and ask questions of the presenters and other local experts.

123. Offer polite reminders to friends, family and colleagues concerning conservation efforts.

124. Help teach friends to empathize with the citizens of developing nations. Increase their awareness of global ecological issues and teach basic economics for a more complete understanding. Combat myths like "exports are always good."

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125. Be open to changing lifestyles as you become more aware of the impact each individual has on the whole society and the environment.

126. Educate students about environmentally-oriented jobs and volunteer opportunities.

127. Inform schools, hospitals, airlines and the media of your food concerns.

Working for a Change: Citizen Action

One of the most effective ways of protecting your environment is to address the people who have a greater influence over its condition, such as politicians and corporate heads. These people feel compelled to respond to consumer and constituent demands, so citizens who express their views can have a tremendous impact.

Each of us has a chance to influence our government and the governments of other countries. Even when we cannot vote, we can write letters, join political groups, participate in their activities, and support candidates for office.

128. Find out where the candidates stand on environmental and population-related issues for elections at local, state and national levels. Vote for those candidates who you believe will have a positive effect on our environmental situation. Write to the candidates who do not receive your vote to voice your concerns.

129. Patronize businesses that express an interest in environmental causes and activity; encourage them to donate a small percentage of their profits to good causes.

130. Demonstrate against major polluters and open-space destroyers by picketing, rallying, attending hearings or submitting testimony in writing.

131. Write to manufacturers and voice your concerns about excessive packaging and processing. Don't buy their products until you can rest assured that something is being done.

132. Write to your local environmental protection agency, coastal commission, department of parks and recreation or to the U.S. Department of the Interior and find out what they are doing to protect our wilderness, wildlife and open space. Demand that they do everything within their power to keep our environment safe and clean.

133. Write to your local newspapers expressing your greatest concerns about environmental and population issues and make suggestions as to how the readers can help make a difference.

134. Boycott products made by companies that pollute the environment or exploit poor nations. Write to them and voice your opinion.

135. Write to local stores, fast food restaurants, etc., asking that they stop using polystyrene foam products.

136. Investigate and support local efforts to preserve farmland. Write to a legislator or councilperson urging their support for the preservation of farmland.

137. Become active by speaking to groups or visiting policymakers to air your personal concerns or represent the views of your population or environmental organization. Talk to your local PTA about sponsoring a speaker from your organization.

138. Notify program directors of radio and television stations of newsworthy stories with environmental impact. Praise shows and news coverage that address problems of the environment and overpopulation, and express your disapproval towards those that do not.

139. Write to fast food chains expressing your concern about their throw-away practices and importation of beef from developing countries.

140. Write or talk to a state or national legislator on local and global food issues and U.S. aid or foreign policy.

141. Contact your city council and urge the necessity of citywide recycling.

142. Contact a legislator concerning use of pesticides on forests and farms.

143. Write a letter to overseas timber companies expressing concern for their erosion-control practices.

144. Write a letter to your representatives in Congress asking that pesticides banned in the U.S. not be exported overseas.

145. Promote better laws and law enforcement concerning all areas of the environment. Write letters to elected officials in all levels of government to insist that money be made available to enforce environmental laws. Ask that administrators in charge of law enforcement be instructed to carry out the laws which are there. Give specific suggestions to improve existing laws and/or for new ones.

146. Help to support local, national and international environmental organizations by donating money or goods or volunteering your time. They may appreciate your help staffing a booth at a local fair, participating in a walk, conducting workshops or helping to canvass for funds. Let them know when they're doing a good job.

147. Research to identify effective overseas development programs and organize school and community support.

148. Participate in demonstrations and rallies. Sign and distribute petitions. Organize letter-writing sessions. Your personal involvement makes a difference.

149. Organize a leafletting campaign in your neighborhood or city, or leaflet by yourself door-to-door, in shopping centers, etc.

150. Distribute posters for the organization with which you are involved or construct an exhibit to display in shopping centers, the lobbies of large buildings, schools, etc.

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SELECTED RESOURCES ON POPULATION

COMPILED BY
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BOOKS ON POPULATION

The Crowded Earth: People and the Politics of Population, Pranay Gupte, 1984, New York: W.W. Norton & Company, 349 pp., $17.95, ISBN 0-393-01927-6

Pranay Gupte approaches the population problem as a journalist. His story resulted from an extensive journey to five continents where he documented the impact of population programs on the lives of the people. As the author explains, "Population is not a story that can be told in a clinical fashion, and I haven't attempted to do so. The blood, gore, tears, laughter, and joy in the following pages are those of the people I met, but also of mine."

Gaining People, Losing Ground: A Blueprint for Stabilizing World Population, Werner Fornos, 1987, The Population Institute, 100 Maryland Avenue NE, Washington, DC 20002, 121 pp., $6.45

This up-to-date work summarizes recent population trends and outlines characteristics of present growth affecting cities, health, ecology, economies and international security, among others. It describes factors affecting fertility, and examines closely the situation in 20 nations. The conclusion discusses recent setbacks in population programs and a call to action.

Multidisciplinary Perspectives on Population and Conflict, Nazli Choucri, Editor, 1984, Syracuse: Syracuse University Press, 220 pp., $30.00 (h) $13.95 (p), ISBN 0-8156-2315-1

Population problems include not only those related to fertility, mortality and migration, but also the dynamics of demographic change as they affect the socioeconomic, political and environmental conditions prevailing in countries. Based on a multidisciplinary approach, this collection of essays discusses the implications of these population factors for manifestations of conflict at the interpersonal, national and international levels.

Reflections on Population, Rafael M. Salas, 1985, Elmsford, NY: Pergamon Press, 240 pp., $48.00, ISBN 032406-1

This book is a sequel to *International Population Assistance: The First Decade*, published in 1979, which defined population concepts governing the United Nations Fund for Population Activities' (UNFPA) operations. With the 1984 International Conference on Population in mind, Mr. Salas, UNFPA Executive Director, felt that an additional volume was needed to characterize the work of the Fund with the developing countries up to 1984 and to relate these experiences to the issues before the conference. Reflections on UNFPA's work can assist the reader in thinking about the future of population trends.

The State of World Population 1989, Dr. Nafis Sadik, Executive Director, 1989, UN Population Fund, 220 East 42nd Street, New York, NY 10017, 34 pp., free

The 1989 edition of this annual publication focuses primarily on the changing position of women in the coming decade. The report examines the linkage between their productive and reproductive roles, as well as their status in population development and changes. The text covers nutrition, pregnancy, infant mortality rates and the impact of AIDS for the female populations of developing countries. Emphasis is placed on the need for global health care programs and governmental recognition of the woman's role in population and environmental development for future policies.

World Population & U.S. Policy: The Choices Ahead, Jane Menken, Editor, 1986, The American Assembly, New York: W.W. Norton & Company, 255 pp., $18.95 (h), $8.95 (p), ISBN 0-393-30399-3

What policies should guide the United States in a world that will double its population in less than 40 years? To slow population growth, should we continue the Reagan administration's promotion of free market economic development, as opposed to family planning? Eight experts from the American Assembly, a center for policy studies at Columbia University, share their views about global population issues and choices. Their articles provide background on immigration demographics, economic development trends and family planning.

World Population: The Present and Future Crisis, Headline Series 251, October 1980, Phyllis T. Piotrow, Foreign Policy Association, 205 Lexington Avenue, New York, NY 10016, 80 pp., $2.00

This introductory guide to world demography encompasses past and future population trends, compares population growth in developed and developing countries, and examines the relation of fertility to development. The final chapter covers policies and agencies of the population field.

BOOKS ON THE ENVIRONMENT

Building a Sustainable Society, Lester Brown, 1981, New York: W. W. Norton and Co., 433 pp., $14.95 (h) $9.95 (p), ISBN 0-393-30027-7

Lester Brown of Worldwatch Institute argues that our escalating food demands, like those of the Mayans, are leading to topsoil losses that are eroding the foundation of civilization itself. Deforestation, overgrazing, and overfishing are shrinking the economy's resource base, leading to the biological equivalent of deficit financing. Yet, unlike the Mayans, we know the course corrections needed to put us on a sustainable path.

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New Programs Tackle Teen Pregnancy

Population and the Greenhouse Effect

Social Security: Safe or Suffering?

The Supreme Court and Reproductive Rights

Sustainability: The Global Challenge

The Urbanization of Suburbia

Voting to Slow Growth

Water Wars

Where Will All the Forests Go?

HANDBOOKS AND WALLCHARTS

Country Rankings of the Status of Women: Poor, Powerless and Pregnant, Population Crisis Committee, 1988, 1120 19th Street NW #550, Washington, DC 20036, free in limited quantities

A thorough overview of the status of women worldwide. Covers health, marriage and children, education, employment and social equity. Includes accompanying color wall chart.

GAIA: An Atlas of Planet Management, Dr. Norman Myers, Editor, 1984, New York: Anchor Press, Doubleday and Company Inc., 272 pp., $29.95

An assessment of humankind's place on the planet Earth, the damage humans have done to the environment, and the steps that can be taken to remedy this damage. Introductions by experts, innovative charts and maps, and colorful design make this atlas an exciting resource.

Human Numbers and Human Needs, Paul Harrison and John Roley, 1984, International Planned Parenthood Federation, 18-20 Lower Regent Street, London SW1Y 4PW, England, 64 pp., $5.00

This handbook originated from the work of IPPF's *People* magazine which reports on national and international efforts to promote planned parenthood and improvements in the status of women, education, health and living conditions. Also looks at how population growth along with mounting consumption have affected the planet's resources and examines efforts to bring about a sustainable balance.

The International Human Suffering Index, Population Crisis Committee, 1987, 1120 19th Street NW #550, Washington, DC 20036, $5.00

Statistically rating living conditions in 130 countries, this index was created to measure differences in living conditions between countries. The colorful chart also allows a side-by-side comparison of rates of population increase and human suffering.

Life Expectancy at Birth and Population Growth Rate, World Bank Publications, 1987, Department 0552, Washington, DC 20073-0552, $6.00

Each of these kits contains a colorful map of the world (24" x 36") with data on 148 countries, easy-to-read text, 3 charts illustrating key concepts, 6 photographs that depict the people behind the statistics, and a comprehensive teaching guide with a full range of activities.

1989 World Population Data Sheet and The United States Population Data Sheet, Population Reference Bureau, 777 14th Street NW #800, Washington, DC 20005, $3.00 plus $1.00 shipping (bulk rates available)

Handy, readable wallcharts (18 ½" x 24") providing a variety of the latest population-related statistics. *World Population Data Sheet* published each spring; *U.S Population Data Sheet* published each fall.

Population Handbook, Population Reference Bureau, 777 14th Street NW #800, Washington, DC 20005, 1985, 75 pp., $5.00 (bulk rates available)

A guide to fertility, mortality, population change and other demographic basics. Available in three specially adapted editions: U.S., French and International.

USA By Numbers, Zero Population Growth, 1988, 1400 16th Street NW #320, Washington, DC 20036, 164 pp., $9.95 ($1.50 postage and handling)

This study looks at population-linked social, economic and environmental indicators in the United States and reports on trends within states, cities and regions. It covers a wide range of population related issues from fertility rates to teenage pregnancy, unemployment to child poverty, air and water pollution to land and wildlife.

World Access to Birth Control, Population Crisis Committee, 1987, 1120 19th Street NW #550, Washington, DC 20036, free in limited quantities

The first study to rate 110 countries, it ranks the 15 most populous industrialized countries and 95 less developed countries for availability of birth control methods, services, education and government leadership. Accompanying wallchart.

VIDEOS AND FILMS

Unless otherwise noted all videos and films listed below are available for rent from the Population Reference Bureau, 777 14th Street NW #800, Washington, DC 20005. $20/five working days, includes postage and handling.

A Finite World, 1982, 60 minutes, ¾" U-Matic, Turner Broadcasting System

A documentary exploring the world population situation in seven Asian countries—Singapore, Hong Kong, Indonesia, Thailand, India, Bangladesh and Sri Lanka—and three African countries— Kenya, Egypt and Tunisia. The program focuses on "the crisis situation presented by rapid population growth, and the manner in which each country has come to grips with it."

Increase and Multiply? 1987, 60 minutes, ½" VHS, $25.00, available for sale only from the Better World Society, 1140 Connecticut Avenue NW #1006, Washington, DC 20036

Addresses the human, natural resource and social impacts of exponential population growth in the Third Wold, and the need for increased family planning assistance. The program covers Zimbabwe, Kenya, China, Guatemala and Mexico and examines implications of recent policy shifts by the U.S. government.

The Lorax, 1972, 25 minutes, 16mm, BFA Educational Media

This film version of Dr. Seuss' enlightening children's book is the story of a beautiful woodland's destruction as economic demands lead to excessive use of its natural resources and rapid population growth adds to the environmental stress. This story can be used to introduce young children to a variety of concepts related to population growth in a most entertaining way.

Population Change and Economic Development, 1987, 25 minutes, ¾" U-matic and ½" VHS, World Bank

Based on the World Bank's 1987 report, *Population Change and Economic Development*, this film makes very clear the connections between these two processes. The film opens with a graphic display of the historical growth of world population and projections for the future. It explains the rapid growth being experienced in developing countries, and why such rapid growth is a great burden for these countries. It also discusses official population policies and their place in the extremely personal realm of family planning.

Tomorrow's World, 1984, 24 minutes, 16mm, Perennial Education, Inc.

This film begins with an overview of population growth throughout the world to the year 2000. It then outlines the consequences of continued rapid growth to the food supply and economy. By examining family planning programs in Tunisia, Thailand and Mexico City, the film captures the diversity of the programs and their levels of acceptance within the various communities. Produced by the United Nations.

What Is the Limit?1987, 23 minutes, ½" VHS, National Audubon Society, 801 Pennsylvania Avenue SE, Washington, DC 20003 (Also available for sale for $25 from National Audubon Society)

An in-depth look at the interrelationships between population, environment and development issues. Concludes with discussion of the political and ethical issues concerning population growth.

World Population, 1989, 4 minutes, 16mm and ½" VHS, Zerc Population Growth, 1400 16th Street NW #320, Washington, DC 20036, $29.95 plus $3.00 postage and handling

This new remake of the popular 1972 film provides a graphic presentation of world population growth and distribution from 1 A.D. to the year 2020. The new edition uses colorful computer graphics to illustrate the human population's exponential growth, culminating in a population explosion.

Note: For a more extended film/video list, please contact the Population Reference Bureau's film library at 777 14th Street NW #800, Washington, DC 20005.

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100 Predictions for the Baby Boom The Next 50 Years, Cheryl Russell, 1987, New York: Plenum Press, 249 pp., $17.95, ISBN 0-306-42527-0

Armed with statistics and trends, Editor-in-Chief of *American Demographics* magazine Cheryl Russell prognosticates the future for the baby boom generation. She predicts who will be rich, what the future for the American family is, which businesses will flourish and which will die, how the baby boomers will entertain themselves, how they will tend to their children, and finally, how this youthful and sometimes extravagant generation will grow old.

Planning the Ideal Family: The Small Family Option, Zero Population Growth, 1400 16th Street NW #320, Washington, DC, 20036, $5.00 plus $1.50 postage and handling

This report provides a comprehensive overview of the economic, environmental, and social advantages of keeping families small. An impressive array of facts and figures helps to illustrate the report's findings. The publication also includes a fascinating summary of the trends in U.S. family size, from past to present.

The Population Bomb, Dr. Paul R. Ehrlich, 1968, New York: Ballantine Books, 201 pp., $3.50, ISBN 345-33834-0

In 1968, the Earth's population was well over 3 billion; few countries acknowledged the need for population control. In this climate, Paul Ehrlich, a biologist, announced the perils of an impending population explosion. In this landmark book, Ehrlich describes the dangers of unchecked world population growth. He proposes what nations and individuals can do to combat that growth and resulting widespread famines and environmental deterioration. An acknowledged classic in the area of population studies, the book will be re-released in 1990.

Population Change and Economic Development (World Development Report 1984), The World Bank, 1984, New York: Oxford University Press, 286 pp., $12.95, ISBN 0-19-520460-3

An in-depth analysis of population change and its links with development, showing why continuing rapid population growth is likely to mean a lower quality of life for millions of people. The Report outlines public policies to reduce fertility that are humane and affordable and that complement other development efforts, placing special emphasis on education for women and increased family planning services.

Population in an Interacting World, William Alonso, Editor, 1987, Cambridge: Harvard University Press, 286 pp., $30.00, ISBN 0-674-69008-7

An outcome of a 1983 conference at Harvard University on population interactions between rich and poor countries, this volume concentrates on the demographic gap between the developed and developing countries. Nine essays explore the interplay of demographic variables including international migration, refugee movements, guest workers, tourists and visiting experts.

Earth, Anne H. Ehrlich and Paul R. Ehrlich, 1987, New York: Franklin Watts, 258 pp., $19.95, ISBN 0-531-15036-4

An analysis of the planet's current health which looks at the origin, character and extent of the changes brought about by human action. It offers startling facts, as well as controversial and new ideas on subjects such as population growth, industry and agriculture, land and building development and nuclear armament.

The Global Possible, Robert Repetto, Editor, 1985, World Resources Institute, New Haven: Yale University Press, 538 pp., $14.95, ISBN 0-300-03505-5

This book is a broad overview of the state of the world's threatened resources. Drawing on evidence from recent experiences in many countries, it proposes realistic and politically practical corrective measures. Written by experts in various areas of environmental research and policy, essays range from how we can improve energy efficiency in transportation, housing, industry and agriculture to evaluations of mechanisms that would control atmospheric pollution on an international level.

The Global 2000 Report to the President: Entering the 21st Century, Council on Environmental Quality, Department of State, Gerald O. Barney, Study Director, 1980, U.S. Government Printing Office, Washington DC 20401, 766 pp., $14.00

In 1977, to create an agenda for long-term environmental planning, President Jimmy Carter ordered a study of the "probable changes in the world's population, natural resources, and environment through the end of the century." The completed three-year study suggests there is a progressive degradation of the Earth's resource base and new international initiatives are required to better manage and conserve basic resources.

The Limits to Growth, Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William Behrens III, 1972, New York: The New American Library, Inc., 207 pp., $3.95, ISBN 02-451-13695-0

The creators of this historic book present a written world model to explain long-term global trends. Covering 100 years into the future, the model investigates industrialization, population growth, malnutrition, depletion of resources and deterioration of the environment. This explanation is nontechnical and helps the reader visualize complex issues.

Our Common Future, World Commission on Environment and Development, 1987, Oxford University Press, U.S.: 200 Madison Avenue, New York, NY, 10016, 400 pp., $10.95, ISBN 0-19-282080-X

Established by the United Nations in 1983, WCED's mission was to re-examine the critical environment and development problems on the planet and to formulate realistic proposals to solve them. The result of a three-year effort by this independent body, this report shows that through policies of cooperation and the application of the best of current technologies, environmental damage can be controlled while societies around the world assure their peoples higher standards of living.

State of the Environment: A View Toward the Nineties, The Conservation Foundation, 1987, 1717 Massachusetts Avenue NW, Washington, DC 20036, 586 pp., $19.95, ISBN 0-89164-084-3

This book reviews the U.S.' progress in improving the condition of its environment and the management of its natural resources. A long-term view of the nation's environmental picture is taken in an effort to ask the questions and provide the information that policymakers and other concerned individuals will need as the nation approaches the 1990s. In addition, the book takes a global approach, recognizing that the U.S. increasingly must formulate its environmental policies with a careful appreciation of its interrelationships with the rest of the world.

State of The World 1989, Lester R. Brown, Editor, 1988, Worldwatch Institute, New York: W.W. Norton & Company, 237 pp., $18.95 (h) $9.95 (p), ISBN 0-393-30440-X

In its sixth annual examination of the world's ecological health, the Worldwatch Institute focuses on problems of population growth, land degradation, ozone depletion, global warming, over-reliance on automobiles, and the global AIDS epidemic. This volume is an invaluable resource for educators, policymakers and concerned citizens worldwide. Last year, *State of the World* was adopted for use in 751 courses in 451 colleges and universities.

Sustainable Development: A Guide to "Our Common Future", The Global Tomorrow Coalition, 1325 G Street, NW #915, Washington, DC 20005-3104

As a brief synopsis and primer on sustainable development, the guide was designed to introduce the work of the World Commision on Environment and Development, illuminate its major findings, describe some of the worldwide reaction to the report, and invite participation in the growing dialogue on the role and responsibility of the United States in attaining global sustainable development.

U.S. Carrying Capacity: An Introduction, Maryla Webb and Judith Jacobsen, 1982, Carrying Capacity, Inc., 1325 G Street NW #1003, Washington, DC 20005, 79 pp., $2.00

Soils and other renewable resources are being used faster than they can be replaced. How long can this go on? Will technology come to the rescue as it has in the past? How many people can the U.S. support and at what quality of life? This study investigates these problems and possible ways of making resource use more efficient, reducing waste and working toward a sustainable population.

World Resources 1988-89, International Institute for Environmental Development, World Resources Institute, 1987, New York: Basic Books, Inc., 369 pp., $16.95 ISBN 0-465-09239-X

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The *World Resources* annual reports provide objective, current global assessments of the natural resource base supporting the global economy. They are designed to complement the established annual reports surveying the economic and political landscape. Issues examined range from population/health, human settlements, and food/agriculture to wildlife/habitat, atmosphere/climate and global systems and cycles. This latest edition thoroughly assesses the world's natural resource base using 50 data sheets covering 146 countries. As a special focus, the book explores the implications of rapid population growth for the environmental conditions in Asia.

A DIFFERENT VIEWPOINT

The Birth-Dearth: What Happens When People in Free Countries Don't Have Enough Babies? Ben Wattenberg, 1987, New York: Pharos Books, 192 pp., $16.95, ISBN 0-345-34399-9

Mr. Wattenberg contends that the continuation of low fertility levels in 22 nations he deems modern and industrial could doom Western civilization. He reviews specific economic, geopolitical and personal problems resulting from the "birth dearth" and prescribes governmental intervention to boost birth rates.

The Fear of Population Decline, Michael S. Teitelbaum and Jay M. Winter, 1985, Orlando: Academic Press, Inc., 201 pp., $22.50, ISBN 0-12-685191-3

Teitelbaum and Winter take a rational approach to declining fertility rates in Western nations. The authors discuss the concept of "birth dearth" in broad historical perspective, noting past trends and anxieties and commenting on likely demographic trends for the near future. Also included in the analysis are the policy and political implications in the industrial West of aging populations, immigration and lower birth rates.

The Ultimate Resource, Julian Simon, 1981, Princeton: Princeton University Press, 415 pp., $9.95, ISBN 0-691-00369-6

Simon looks to the future with the belief that the ultimate resource is the human imagination. He maintains that energy, food, and materials are not finite in any meaningful way and that using resources now will not slow the rate of future economic progress. This nontechnical and expanded version of his book, *The Economics of Population Growth*, suggests that additional population leads to improvements in economic well-being.

BULLETINS

Population Bulletin, Population Reference Bureau, 777 14th Street NW #800, Washington, DC 20005, $4.00/year

Quarterly booklets written by experts on world and national demographic trends and their implications. Recent topics featured include: "Immigration to the U.S.," "Population Pressures in Latin America," and "World Population in Transition."

The Worldwatch Paper Series, Worldwatch Institute, 1776 Massachusetts Avenue NW, Washington, DC 20036, $25.00/year

Issue papers produced by an independent, nonprofit research organization created to analyze and to focus attention on global problems. There have been 80 Worldwatch papers including recent ones such as: "Planning the Global Family," " Defusing the Toxics Threat," and "On the Brink of Extinction."

MAGAZINES

American Demographics, American Demographics, P.O. Box 6543, Syracuse, NY 13217, $48/year, $6/issue

A monthly magazine that features articles about current trends, facts, forecasts, profiles and other facets of U.S. demographics.

Family Planning Perspectives, The Alan Guttmacher Institute, 111 Fifth Avenue, New York, NY 10003, $5/issue

A bimonthly magazine that discusses current family planning issues, featuring reports on the latest abortion and women's rights laws, the most recent breakthroughs in birth control, and up-to-date statistics on family planning in the U.S.

People, International Planned Parenthood Federation, c/o Longman Group Ltd., Subscriptions (Journals) Department, Fourth Avenue, Harlow, Essex CM19 5AA, England, $20.00/year

A quarterly international development magazine reporting on efforts to balance population and resources, promote planned parenthood and improve the human condition.

World Watch, World Watch, P.O. Box 6991, Syracuse, NY 13217-9942, $20.00/year

A bimonthly magazine from the Worldwatch Institute featuring articles of national and global concern on issues such as climate change, soil erosion, energy efficiency, ozone depletion, water scarcity, new recycling technologies and population trends.

NEWSLETTERS

Greenhouse Gas-ette, Climate Protection Institute, 5833 Balmoral Drive, Oakland, CA 94619, free

This newsletter introduces creative ways for educators to teach students about global warming. Activities appropriate for students from fifth grade through college are featured, along with updates on national global warming legislation and international conferences.

Population Today, Population Reference Bureau, 777 14th Street NW #800, Washington, DC 20005, $40.00/year for membership, $2.00/single issue

A 12-page newsmonthly covering population trends and events in the U.S. and worldwide.

Populi, United Nations Fund for Population Activities, 220 East 42nd Street, New York, NY 10017, $14.00/year, $4.00 single issue

A quarterly publication with selected articles from various international writers promoting awareness of the social, economic and environmental implications and of national and international population problems and human rights aspects of family planning.

Sierra Club Population Report, Population Growth Policy Program, Sierra Club, 730 Polk Street, San Francisco, CA 94109, free with membership ($25/year)

This publication alerts readers about international and national population-related legislation, local growth issues and demographic news. It emphasizes how citizens can become involved and help influence critical environmental legislation.

Teachers' PET Term Paper, Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036, $3.00/year

A quarterly newsletter for educators involved in population education efforts. Includes population education training opportunites, activities for elementary and secondary classes, reviews of books, audiovisuals and curricula, and a readers' exchange forum.

ZPG Activist, Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036, free by request with membership ($20/year)

A newsletter for ZPG chapter leaders and local activists. Issued four times a year with ideas on how to get involved locally in population issues, legislative action alerts, new population resource materials, and in-depth background articles on critical population issues.

ZPG Reporter, Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036, $7.50/year or free with membership ($20/year)

ZPG's national bimonthly newspaper reports on global population issues, the impacts of growth on local communities, national population legislation and more.

FACTSHEETS

The following can all be obtained from Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036, single factsheet free, 2-49 factsheets $0.25 each

- **Airborne Poisons**
- **Bumper to Bumper, Coast to Coast**
- **Computer Software for Population Education**
- **Demographic Facts of Life in the U.S.**
- **Fact versus Fiction: The Birth Dearth**
- **The Garbage Crisis**
- **Global Warming: A Primer**
- **More People, More Trash Turn Nation to Recycling**

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SOFTWARE*

MATHEMATICAL MODELS

Population Concepts, Educational Materials and Equipment, 4 Old Mill Plain Road, P.O. Box 2805, Danbury, CT 06183-2805. Includes 2 disks, study guide, 6 student workbooks, $47 for Apple II; $41 for TRS 80 model III, 4; $52 for IBM

This secondary biology program consists of two parts, an introduction and an experimental mode. The introduction defines basic population concepts and illustrates them with lively graphics. The experimental mode offers 3 models, illustrating exponential population growth and the effect of limitations such as carrying capacity and low breeding density. This program offers a good introduction to population concepts and may be especially beneficial to those students who are not mathematically inclined.

What if? Pikes Peak Software, 2740 Villa Loma Drive, Colorado Springs, CO 80917. 2 disks, instructions, worksheets, answer sheets, $54.95 for Apple C or IIe with an 80 column cord

What if? includes three programs for high school or college students addressing population ecology, immunity, and U.S. population growth. The U.S. Population Growth program illustrates these statistics for 1760 to 1980 by showing a new dot on the U.S. map (and sounding a beep) each time 200,000 people are added. This graphically demonstrates the increasing speed of population growth, the relative density of different areas, and the westward movement of the population's geographic center over time. Another simulation allows students to set the growth rate and observe projected future population growth as more dots appear on the map.

DATABASES

Each of the following is available from Active Learning Sytems, 5365 J Avenue, Encinas, Carlsbad, CA 92008. Each contains 2 disks, user's manual, teacher's notes and student worksheets. $148.00 each for Apple IIc or IIe, IBM PC/PCjr., Commodore 64, or Tandy Radio Shack

Hometown: A Local Area Study

Hometown offers a framework for students to create their own database, using data from demographic surveys they conduct in their own hometown. The class activity package is an excellent means of giving students a feeling of involvement in their community as they talk with people and learn about their area's history and what is currently taking place there. At the same time, they develop skills for surveying, interviewing, recording data and analyzing it with the help of the computer.

One World: Countries Database

This computer reference file contains demographic, economic, geographic and political information about 178 nations. There are 33 items of data for each country, including capital city, head of state, previous name, geographic neighbors, imports and exports, population size, percent rural and urban, percentage of land that is forest, desert, or cultivated, languages, religions, treaties and alliances, among others. An editing feature allows users to update 5 of these categories for which the data change frequently.

USA Profile: Social and Geographical Database

For each of the 50 states and the District of Columbia, the computer reference file contains 60 items of information, including place names, geographical information, industry and natural resources, and several varieties of demographic information, such as population size, percent urban, age distribution, population age 25 and over, education levels, and mobility of households. The package also includes 6 classroom study units on early American history, environment, population and urbanization, employment and unemployment, income distribution and the family.

PROBLEM SOLVING GAMES

Decisions, Decisions, Tom Snyder Productions, 90 Sherman Street, Cambridge, MA 02140. *Immigration* and *Urbanization* cost $119.95 each. Each contains 2 disks, instructions, lesson plans, reproducible student worksheets, 25 student reference workbooks. For Apple II (48 K), IBM PC/PCjr., or Tandy 1000

Each *Decisions, Decisions* program presents a "You are There" situation requiring students to examine options, make a series of decisions, and experience the consequences of their choices. Along the way, "advisors" express various points of view and refer to historical situations and current policies that may shed light on their dilemmas. *Immigration: Maintaining an Open Door* places the students in the role of a U.S. president faced with responding to a large influx of uninvited refugees shortly before the electoral primaries. *Urbanization: The Growth of Cities* puts students in the role of a small-town mayor confronting the prospect of sudden rapid growth when a valuable resource is discovered in the area.

Note: For a more comprehensive list of software reviews, see the ZPG factsheet, Computer Software for Population Education. For price information, contact Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036.

SPECIAL PUBLICATIONS

National Geographic, The National Geographic Society, 17th and M Streets NW, Washington, DC 20036, back issues $2.25 general public, $1.80 classroom use

National Geographic calls for a "new era of global responsibility" in its beautifully illustrated 100th anniversary issue (Dec. 1988). Featured in the magazine is a series of essays and articles about population growth, including "Population, Plenty and Poverty" by Drs. Paul and Anne Ehrlich, which compares population problems in Kenya, China, India, Brazil, Hungary and the United States.

Population, Environment and Resources, and Third World Development, Pradip K. Ghosh, 1984, Greenwood Press, Congressional Information Service, 88 Post Road West, Westport, CT 06881, ISSN 0738-1425, no. 5

Part three of this straightforward and informative work offers a thorough research bibliography essential for anyone seeking in-depth information on environmental issues. The entries are ranked under four classifications and entail much cross-indexing. The headings read: A) Problems, Issues and Trends; B) Analytical Methods; C) Strategies and Policies; and D) Country Studies.

Scientific American, 415 Madison Avenue, New York, NY 10017 $3.95 (includes postage and handling), bulk prices available

Scientific American devotes its entire September 1989 issue to "Managing Planet Earth." Topics covered include global warming, threats to biodiversity, human population growth and strategies for working toward a sustainable world.

Urban Stress Test, Zero Population Growth, 1400 16th Street NW #320, Washington, DC 20036, $4.95 plus $0.75 postage and handling

ZPG's 1988 *Urban Stress Test* is a national survey ranking large metropolitan areas by the population-linked pressures affecting their social, economic and environmental well-being. Almost 200 major U.S. cities are put to the test, using 11 interrelated criteria to measure a community's liveability and its residents' quality of life.

September 1989

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BURSTING WITH GROWTH

Concept: Quality of life is a factor in determining optimal human population size.

Objective: Students consider optimal population size for their own community by simulating a city council meeting where local growth issues are discussed.

Subject Areas: Social Studies, Science

Introduction:

Population growth is a concern not only in developing countries, but in our own communities in the U.S. As major urban areas become congested, development spreads out into small towns and suburbs, changing the look and character of these places. Great controversies have sprung up in cities and towns throughout the country where some residents wish to slow or stop local growth to preserve the environment, while other residents encourage it for the economic benefits it could bring to the community.

In the following simulation, students act as residents of Bursting, a fictitious town which has become increasingly more developed over the last 20 years. Continued growth threatens the town's water supply. Residents discuss the future of their town in a model city council meeting.

Materials:

Role-playing cards (duplicating masters provided)

Procedure:

1. Make a copy of the role card master to cut up into separate cards. Give one card to each of seven volunteers. The rest of the participants will be the audience at the city council meeting and should feel free to offer opinions and proposals after the presentations have been made.
2. Give those who have roles a few minutes to study their parts. Encourage them not only to read their cards, but to act in a way that is consistent with their roles and that represents the information supplied in the role description. They should try to be as persuasive as possible. In order for students to feel comfortable with their roles, additional research and preparation may be useful.
3. When they are ready to start, have the president open the meeting and call on each presenter in turn. Members of the council can ask questions after each presentation, but there should be a time limit. Most of the questioning and discussion should take place after all the presentations have been made. The audience can also participate at that time.
4. Conclude the simulation with a vote by the city council on the resolution offered by Urthmon.

Discussion:

1. If the council voted for the resolution, what were the most important considerations in deciding to limit growth?
2. If the council voted against the resolution, what solutions to the problems of growth (e.g. water supply) were offered?
3. Is your community, or any of your neighboring communities facing a rising demand for a resource in short supply (like in the city of Bursting)?
4. Should steps be taken to limit population growth or to limit people's consumption of that resource?

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Extended Learning:

1. If similar debates over local growth have reached your local city council, encourage students to sit in on a meeting and take notes on the discussion.

2. Just as the water supply in Bursting is finite, the supply of natural resources, including food, is finite throughout the world, while the population continues to grow. Explain to students that the current population of over five billion is growing by 93 million each year. At this rate, the population of the Earth will double in 39 years. Can enough food be produced to feed a world population that doubles every 39 years? Currently, enough food is produced to feed over five billion people but 20% of all people suffer from malnutrition. Why is this so? Even if food were to be distributed equitably among all, would a point be reached when there would not be enough food for everyone? What can be done?

Adapted by permission from *Simulations for a Global Perspective*, Global Perspectives in Education, a program of The American Forum, New York, NY, 1985.

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CITY COUNCIL ROLE CARDS

M. Fehrminder—City Council President

There are two items of business at this meeting. One is the request of a real estate developer for permits to begin building houses on a tract of land at the edge of the city of Bursting. The other is a proposed law that would block further building until a plan for controlled growth has been worked out. Several people have asked to speak at the meeting and you have decided on the following order:

G. Zinger—Real Estate Developer
T. Piper—Water and Sewage Commissioner
W. Urthmon—Environmental Activist
E. Koality—Civil Rights Leader

The speakers have five minutes each. You may invite additional comments from the audience. Other members of the city council will also offer their opinions during the meeting. After hearing all those who wish to speak, you will take a vote in the council on the following resolution:

> Resolved, that no more building permits be issued for the next two years or until a plan has been worked out for carefully controlled growth that will not threaten the natural landscape or our capacity to provide public services — water, sewage disposal, schools, etc.

A. Penn—City Council Member

You own a local hardware store. New houses and an increasing population are good for your business. Your favorite saying is "A town that stops growing, starts dying." Back in 1965, the business people of Bursting weren't prosperous. But now there are big new stores and shopping centers that stay open every evening. Business is booming. So what if it's a bit crowded. The sound of those cash registers is music to your ears, and everyone shares in the prosperity. You are enough of an optimist to believe that somehow or other the water supply problem can be solved. Instead of stopping the building of new homes, the council should appropriate some money to bring in specialists who could work out ways to increase the water supply.

G. Zinger—Real Estate Developer

Ten years ago, you purchased 500 acres of land on the edge of the small city of Bursting. Your honest intention, as a good business person, was eventually to build houses on the land and make a profit. There is now a strong demand for housing in Bursting. You want to begin building. The new houses will be modern and attractive and reasonably priced. They will enable many American families to realize the American dream—a house of one's own in a pleasant community. Building the homes will provide jobs for many local workers for several years. The new homeowners will pay city property taxes averaging $500 a year and will shop at local businesses, thus helping the local economy. Assuming an average family size of four members, the 1,000 new homes will add 4,000 people to the population of Bursting, but it will take at least five years before all the homes are built and occupied. You are respectfully requesting the necessary permits so that you may begin building. If you cannot build, you will suffer a considerable loss because the land is not suitable for agriculture.

E. Koality—Civil Rights Leader

You object strongly to the possibility of a law that would limit the building of new homes. You are concerned about the basic American right to live where you want to live. According to a study by the federal government, over 200 communities have already passed laws or imposed delays that affect new building. It isn't right for an American community to build a wall around itself and deny entrance to newcomers. It is part of our American tradition to encourage and allow the free movement of people. One thing that especially concerns you is a tactic used in some communities. This tactic involves a special tax on water and sewer hookups for new homes. This raises the price of the homes and makes them too expensive for low and middle income families. It's a kind of wall with openings for a select few. That's downright un-American.

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W. Urthmon—Environmental Activist

Your view is that many of the problems we have had with the environment can be traced to uncontrolled growth. In general, Americans have had the notion that people have an almost unlimited right to do whatever they want with the land they own. But our traditional beliefs in unlimited growth and development have to give way to higher rights — the right of the public to a humane environment. One of the most important aspects of a humane environment is to have some uncrowded, untouched land. Show a real estate developer 10 acres of natural land and he sees 40 houses on it. Our aim should be to keep at least some of our landscape in a natural state. The profit motive must not always win. You want the city council to consider a law that would stop further building until there are approved plans to save some of the open spaces around the city. You therefore propose the following resolution:

C. Nile—City Council Member

You have lived in the city of Bursting for 30 years. When you first moved here it was a small sleepy town that came alive only on Saturdays when local farmers came in to shop. You liked it that way. It was a quiet, peaceful place. But the population has been growing since 1960, and it is no longer a quiet, peaceful place. The meadows are covered with houses, the streets jammed with cars. Maybe it doesn't matter if someone builds another 1,000 houses. On the other hand, perhaps if growth can be stopped, some of the good qualities can be brought back to life. It might be worth a try. But then again . . .

T. Piper—Water and Sewage Commissioner

The city of Bursting has a water supply problem. The consumption of water is 200 gallons per day per person, while the maximum supply of water is 12 million gallons per day. Thus, the maximum number of people who can be supplied with water is 60,000 (12 million divided by 200 = 60,000). The population of Bursting has been growing as follows:

> Resolved, that no more building permits be issued for the next two years or until a plan has been worked out for carefully controlled growth that will not threaten the natural landscape or our capacity to provide public services — water, sewage disposal, schools, etc.

Year	Population
1973	19,700
1978	26,360
1983	35,570
1988	48,600
1993	66,400 (projected estimate)
1998	90,730 (projected estimate)

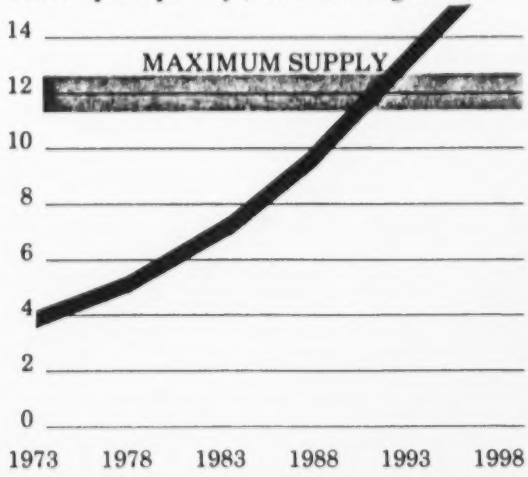
On the basis of your computation, you believe that the population of Bursting will reach the limits of the water supply sometime in 1991.

After you have worked out your estimates, prepare a simple graph on the chalk board or on a large piece of paper. Use this during your report to the city council. The graph might look like the one below.

You may be asked during the city council meeting whether there are any ways to increase the water supply. Your answer should be that this part of the state suffers from a water shortage and you do not believe that the supplies can be increased. In the long run, perhaps 20 years away, there is the possibility of recycling water so a community uses the same water over and over. But that's just a possibility and won't help us now.

SAMPLE GRAPH:

Consumption per day (in millions of gallons)



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COUGAR HUNT

Concept: Every piece of land has a finite carrying capacity for the amount of animals and/or humans it can support.

Objective: Students will gain a better understanding of what is meant by carrying capacity when they act as predatory animals in a finite area and attempt to accumulate enough food to stay alive.

Subject Areas: Science and Math

Introduction:

Every environment has a carrying capacity, the point at which it cannot support any additional member of a given species with the natural resources (food and fuel) it needs to survive. The following simulation illustrates this concept as it applies to a population of cougars. Through follow-up discussion questions and extension exercises, students can see how this concept applies to the human population.

Materials:

100 8 oz. paper cups that represent animals (prey). Each is marked on the bottom as follows:

50 cups marked S (squirrel = 1 kg.)
25 cups marked R (rabbit = 2 kg.)
15 cups marked P (porcupine = 7.5 kg.)
9 cups marked B (beaver = 20 kg.)
1 cup marked D (deer = 75 kg.)

Procedure:

This game can be played outdoors or within the classroom if all the desks are placed on the perimeter of the habitat.

1. Each student represents a cougar that is attempting to amass enough food (50 kg.) to survive for about a month.
2. One cougar has been injured by tackling a big buck and now has a broken leg so that he or she will have to hunt on one leg. Tell the student to either hop, or have his or her leg tied.
3. Another cougar will be blind due to an injury caused by a porcupine. (You can make a blindfold with some black paper and string).
4. One cougar is a female with four cubs and each cub needs 25 kg. of food to live.
5. Each cougar must walk into the habitat to hunt. (Cougars don't run down prey; they stalk it). When a cougar finds a prey animal, he or she picks it up and deposits it at his or her den. The den will be a piece of paper placed at the perimeter of the habitat and will also be used to calculate the total amount of meat amassed. At this time, the student continues to repeat the process until the game is over, picking up just one prey species per trip. Pushing and shoving is not permissible, unless it is kept strictly under control, but remember that in the wild, cougars do not fight over prey, as a resulting injury may kill them.
6. When all the paper cups have been gathered, the game is over. Each student calculates the quantity he or she gathered.

Continued on back page

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Discussion:

1. How many kilograms did each cougar gather? How many cougars can survive in the habitat? If more cougars played the game, would the habitat support more or fewer cougars? Why?
2. How many kilograms did the blind cougar gather? How many kilograms did the cougar with the injured foot gather? How many kilograms did the mother cougar gather? What are the chances of her cubs surviving in this habitat?
3. What would happen to the cougar population if all the rabbits died as a result of a viral infection?
4. What would happen to the cougar population if the water became polluted with pesticides? Why would the concentration of the pollutant be greatest in the cougar?
5. Though this game is about the carrying capacity of cougars in a region, do the same rules apply to humans? How are they similar and dissimilar?

Extended Learning:

Once students have grasped the concept that the size of an animal population depends on the amount of available resources, extend the idea of carrying capacity to humans through one or both of the following two activities: World Real Estate and Bursting With Growth.

*Adapted by permission from Joan Wagner, 9 Valdepenas Lane, Clifton Park, NY 12065.

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DRIVING TO THE LIMIT

Concepts: The importance of the automobile to the American way of life contributes to numerous environmental problems, such as air pollution, global warming, traffic congestion and less unpaved land area.

Objectives:

- Students determine the automobile's impact on land area by calculating amounts of paved land in the country and in their communities.
- Students estimate and verify the amount of outdoor space necessary to meet the oxygen needs of the class.
- Students observe traffic patterns and calculate which types of vehicles are the most energy-efficient.
- Students calculate the amount of carbon monoxide released by automobiles in the U.S. each year.

Subject Areas: Math, Social Studies, Science

Materials:

Pen or pencil and scrap paper for calculations
Student worksheets (duplicated from master)
Calculator (optional)
String

Introduction:

In the United States the automobile is a national passion. There is one car for every two people and close to four million miles of public roads. As the U.S. population increases, the number of cars on the roads also increases. To alleviate traffic congestion, urban planners build new roads or widen the already existing roads, making way for more cars and more congestion. Cars continue to be the major source of air pollution and prime contributors to the global warming phenomenon. The following activities explore some of these "car troubles" and possible solutions to our "overdriven" society.

Activity One: Blacktop Circus

Procedure:

Duplicate the student worksheet provided so that each student will have a copy. Have students complete calculations for Part I of the student worksheet, "Blacktop Circus."

Answers to student worksheet questions:

1. There are a number of correct answers. States such as Colorado and Wyoming are about 60,000 square miles each in area. Students may wish to combine the areas of smaller states (as in the example) to add up to the same amount.
2. Approximately 310 square miles.
3. 56%
4. Answers will vary based on which city block students use for their maps and calculations.
5. Less available oxygen, less natural landscape, less arable land to grow crops, less grazing land for animals, less natural habitat for most species of wildlife, more pollution, etc. (Let students be creative with this.)

Activity Two: Open Spaces

Introduction:

In order for students to see the danger of too much developed land, they must understand the importance of open spaces. In this exercise, students estimate and verify the amount of outdoor space necessary to meet the oxygen needs of the entire class.

Procedure:

1. Show students the stomata of geranium or other leaves, using a magnifier. Explain that oxygen made by the plant exits through the stomata and that almost all the oxygen we breathe is made by plants.

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2. Have students guess how much grass is necessary to provide a person's daily oxygen needs. Tell them it is a square of grass about 1.5 m. x 1.5 m. (or 5 ft. x 5 ft.).
3. Cut a string 6 m. long (20 ft.) for each student. As a class, estimate how large an area would be required to supply the oxygen for all students in the class. Go outside and have each student lay out a 1.5 m. x 1.5 m. square of string (a 5 ft. x 5 ft. square). Make sure students' spaces are adjacent to each other, not overlapping. Compare the actual area with the class estimate.
4. In the classroom, discuss whether it is important that open spaces exist in communities. Help students estimate how much open space is needed to supply all the students in the school with oxygen.

Discussion:

1. Where do people living in the city get their fresh air supply?
2. We need open space for air; why else do we need open space?
3. As the population grows, more land is developed for cities, suburbs and roads. What are the possible consequences of living with more people and less open space?

Extended Learning:

1. Using maps of the community, have students estimate the total area of land devoted to public parks and open space. Discuss whether this amount is sufficient, insufficient or more than sufficient for community needs.
2. Ask each student to estimate the amount of open space needed to provide oxygen for his or her family.
3. Using maps of New York City and current population estimates for Manhattan, have students determine whether Central Park is adequate to meet the oxygen needs of all Manhattan residents.

Activity Three: Traffic Jam

Introduction:

With over 135 million cars on American roads and the number growing every year, it is no surprise that every city in the country experiences traffic congestion. This is especially true since Americans rely more on cars than on any other type of transportation. In U.S. cities like Denver, Houston and Los Angeles, 90% of people get to work by car. Even in New York City, which has a comprehensive mass transit system, cars still account for two-thirds of all work-related trips. Compare this to Europe where only 40% of urban residents use their cars and 37% use public transportation. The remaining 23% of the people walk or ride bicycles. In Tokyo, Japan only 15% of people use cars to get to work.

Procedure:

Have students complete the calculations for Part II of the student worksheet, "Traffic Jam."

Answers to Student Worksheet Questions:

1. a) As the population of Southern California grows, there will be more cars on the roads, causing greater traffic congestion.
   b) 40 minutes.
   c) 80 minutes (1 hour, 20 minutes).
   d) 40 minutes.
2. These answers will vary based on where the student sits to observe traffic.
3. a) 0.5 gallons.
   b) 0.05 gallons.
   c) Bus.
   d) Answers will vary.

Extended Learning:

Have students design a publicity campaign to get people to use/support/build mass transportation in your area. Be sure to include several persuasive arguments.

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Activity Four: Gas In, Gas Out

Introduction:

Cars, trucks and buses play prominent roles in generating all the major air pollutants, especially in cities. Automobiles account for 75% of all carbon monoxide (CO) emissions, 48% of nitrogen oxides and 40% of hydrocarbons in the air. All of this adds up to more smog above our cities and dirtier air for each of us to breathe.

Procedure:

Have students complete calculations for Part III of the student worksheet, "Gas In, Gas Out."

Answers to Student Worksheet Questions:

1. a) 70,875,000,000 gallons
   b) Smaller cars; larger cars
   c) Yes. The supply of gasoline is finite. Also, as gasoline burns it pollutes the air with harmful gases.
2. a) 40 billion grams (88 million pounds)
   b) 40 million kilograms
   c) 40,000 metric tons

Extended Learning:

1. Have students ask their parents how many miles are put on the family car(s) each year. Are there ways to cut back on this amount by making fewer unnecessary trips? Car-pooling? Taking public transportation? Ask each student to report on how much driving their family might be willing to cut back.
2. Have students brainstorm about types of clean, safe energy which might be able to power cars in the future. Students can then make models or draw pictures of their futuristic cars, showing how the car is efficiently and cleanly powered.
3. Introduce "Human Masses, Greenhouse Gases" from this kit, which includes an exercise calculating automobiles' effect on the level of carbon dioxide in the atmosphere.

Activity #1, Problem #4 adapted with permission by Dr. William C. Ritz, California State University at Long Beach.

Activity #2 adapted with permission by Phyllis S. Busch from *The Urban Environment*, J.G. Ferguson Co., Chicago, Illinois, 1975.

Activity #3, Problem #2 adapted from "Getting from Here to There" as printed in *The Everything Including the Kitchen Sink Guide to Environmental Education*, Santa Clara Office of Education, 1978.

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DRIVING TO THE LIMIT
Student Worksheet

PART I: The Blacktop Circus

1. Much of American land has been adapted for the automobile. Over 60,000 square miles of land in the U.S. have been paved over. This is equal to the combined areas of all the New England states (Maine, New Hampshire, Vermont, Connecticut, Massachusetts and Rhode Island) plus New Jersey, Delaware, Maryland and Hawaii. Look in an almanac or atlas of the U.S. to find another land area equivalent to the paved portion. _____
   _____.
2. In American cities, close to half of all the urban space is used to accommodate the automobile; in Los Angeles this figure reaches two-thirds. If the land area of Los Angeles is 466 square miles, how much of that land is devoted to the automobile? _____ square miles.
3. The Department of Transportation estimates that there are 3,874,026 miles of roads in the U.S. and that 2,174,980 miles of roads are paved. Approximately what percentage of public roads are paved? _____%
4. On another sheet of paper, make a map of one city block. Using a tape measure, figure out what percentage of the block's area is devoted to cars (include streets, driveways, parking lots, garages, service stations, etc.). You may have to decide how to count certain measurements. Example: If a house has a garage underneath and one floor of living space above, you might arbitrarily count half the ground floor space as devoted to cars. How is the area devoted to cars changing?
   _____.
   What limits are there for space devoted to cars? _____
   _____.
5. What are the possible consequences of having less unpaved open space? _____
   _____.

PART II: Traffic Jam

1. In Southern California, the average daily freeway speed is now 33 miles per hour. It is expected to drop to 15 mph by the year 2000.
   a) Why will this happen? _____
   b) How much time would it take someone in the Los Angeles area to get to work now if they were traveling 20 miles at 30 mph? (Note: Use the formula Time = Distance/Rate) _____ hours. How many minutes is this? _____ minutes.
   c) How much time would it take that same person to get to work if they could only travel at 15 mph? _____ minutes.
   d) What is the time difference between the two speeds? _____ minutes.

Continued on back page

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2. Find a safe place from which to watch and count traffic.
   a) How many cars pass in ten minutes? _____ cars.
   b) At this rate, how many cars would pass in an hour? _____ cars.
   c) How would the number be different at different times of day? _____.
   d) What causes traffic jams? _____
   _____.
   e) What percentage of cars have only one person in them? _____%
   f) What arrangements has your community made to encourage car-pooling? _____
   _____.

3. Cars require roughly nine times more road space per passenger than buses.
   a) If a person drives 10 miles to work in a car which gets 20 miles per gallon, how much gas is consumed on the way to work? _____ gallons.
   b) If 40 people take the bus 10 miles to work and the bus gets 5 miles per gallon, how much gas does the bus consume? _____ gallons. What is each passenger's share of gas consumed? _____ gallons.
   c) Which is the more energy efficient people-mover? _____.
   d) Does your city or town have a thorough bus system? _____ If so, what does the city do to encourage bus travel? _____
   _____.

PART III: Gas In, Gas Out

1. As everyone knows, cars run on gasoline. In the U.S. the average car burns 525 gallons of gasoline each year. There are about 135 million cars on U.S. roads.
   a) How many gallons of gasoline do all of these cars together burn each year? _____ gals.
   b) Which types of cars burn less gasoline? _____
   _____.
   Which burn more? _____.
   c) Should we be concerned about burning so much gasoline? Why or why not? _____
   _____
   _____.

2. Carbon monoxide is a poisonous gas which is released from our cars' exhaust pipes when we drive. For every mile we drive, 30 grams of carbon monoxide is released into the air, on the average.
   a) If Americans drive about 1.2 trillion miles (1,200,000,000,000) each year, how many grams of carbon monoxide are released into the air each year through automobile use? _____ grams.
   b) How many kilograms? (1 kilogram = 1,000 grams = 2.2 pounds) _____ kgs.
   c) How many metric tons? (1 metric ton = 1,000 kilograms) _____ metric tons.

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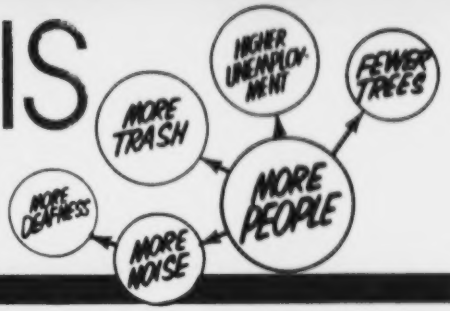
EVERYTHING IS CONNECTED



Concept: Everything is connected to everything else.

Objectives:

- Students identify ways that many factors in human society and the natural environment are interdependent.
- Students analyze the interdependencies demonstrated in a fictional story of rapid development in a formerly undisturbed environment.

Subject Areas: Science, Social Studies

Introduction:

"Everything is connected to everything else" is often called the First Law of Ecology. Here are two activities that encourage students to consider the connections between different things in the natural environment and between the environment and human society.

Activity One: Future Wheel*

Materials:

Chalkboard and chalk

Procedure:

Write a concept such as "More People" in the middle of the chalkboard. Then ask students to suggest some things that more people might lead to, and write these things in a circle around the original concept, as in the example below. Draw arrows to show causal relationships. Continue to build outward in all directions, as in the example. Encourage students to consider social and economic as well as environmental factors in the quality of life.

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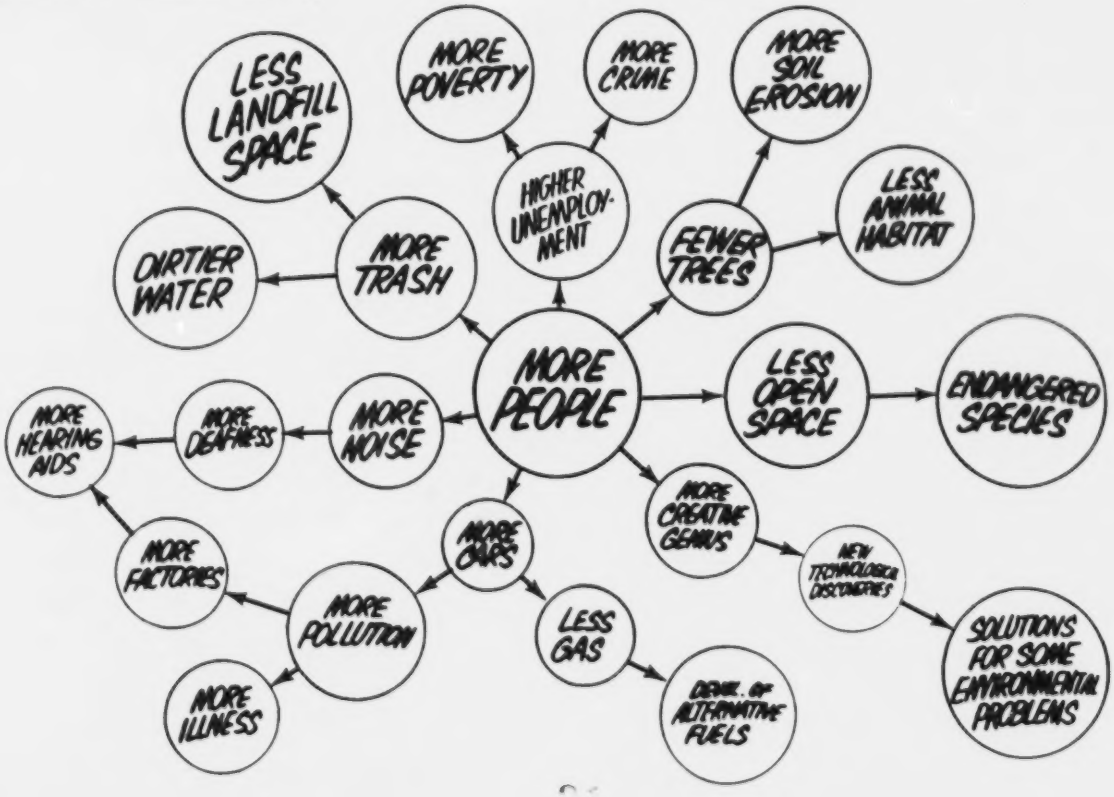

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Activity Two: Lessons from "The Lorax"

Introduction:

The Lorax, by Dr. Seuss (Random House, 1971), is the story of a beautiful woodland's destruction as economic demands lead to excessive use of its natural resources and rapid population growth adds to the environmental stress. You can use this story to introduce students to a variety of concepts related to population growth in a most entertaining way.

Materials:

The Lorax (book or film**) by Dr. Seuss

Procedure:

First, read *The Lorax* to your class or show the film. Then discuss the following questions related to the story with your students:

1. Why did the Once-ler make so many thneeds?
2. How were the animals and birds affected when the truffula trees were cut down?
3. Why did so many more once-lers move to the area?
4. How did the rapid population growth affect the environment?
5. Think about the imaginary land in *The Lorax*, as it was before the Once-ler arrived. Did it remind you of any real place you have seen? Now think about how it looked after the population explosion changed the environment. Did it remind you of any real place you have seen?
6. What could the Once-ler have done that would have allowed him to make thneeds but not harm the environment so much?
7. What could the other once-lers who moved there have done to keep it a nice place to live?

*Activity developed by Jerry Glenn and Cyndy Guy, as printed in *Growth Implications and the Earth's Future*, Education Development Center, 55 Chapel Street, Newton, Massachusetts 02160.

**The 16mm film *The Lorax* may be rented from the Population Reference Bureau, 777 14th Street, N.W., Washington, D.C. 20005; phone (202) 639-8040. It may be purchased from BFA Educational Media, Division of Phoenix Films, 468 Park Avenue So., New York, N.Y. 10016.

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FAMILY PERSPECTIVE

Concepts:

- Each individual's decisions about childbearing contribute to population trends.
- Personal family-size decisions are influenced by the values of the larger society, and one's personal family-size decisions in turn have an impact on the larger society.

Objectives:

- Students calculate family-size trends in their own families and the "society" composed of class members and their families.
- After participating in a simulation, students identify at least two cultural values that may influence an individual's family-size decisions.
- Students discuss impacts their own family-size decisions may have on the larger society.

Subject Areas: Science, Math, Social Studies, Home Economics, Family Life

Introduction:

These two activities encourage students to consider the relationship between individual family-size decisions and population trends in the larger society. It is very important to be nonjudgmental as these matters are discussed in class. The point is not to focus the class' attention on individual students' families or on any particular family size as optimal, but to trace family-size trends generally and examine how individual decisions collectively influence larger population trends. Emphasize that the class is gathering data to determine the average. Some families will always be bigger and some smaller than the average, and this is to be expected.

Activity One: Calculating Family-size Trends

Materials:

Student worksheets (duplicated from other side of this page), one per student
Chalkboard and chalk Calculator (optional)

Procedure:

1. Have students complete questions 1-4 on the worksheet. Students may substitute a guardian or other adult relative for mother or father in answering these questions if they prefer; some students may not have knowledge of a parent.
2. Have a student at the chalkboard write down all the students' answers to 1c as they read them aloud and then calculate an average of these figures, rounding to one decimal place. The result is the average number of children in the students' parents' families, Generation 1. Do the same for Generation 2 and (prospective) Generation 3.
3. Graph these results on the blackboard or on a bulletin board display.
4. Ask students to describe any family-size trends they see in the larger "society" formed by themselves and their relatives. Now have them answer question 5 on their worksheet.

Activity Two: It's a Toss-up*

Materials:

Coin Marker
Paper and pencil Stick-on dots
Calculator (optional) Yardstick/straight edge
Butcher paper

Procedure:

Many students want to have a boy and a girl when they have children, but what happens if they don't get a boy and a girl right away? This exercise simulates the kinds of situations people face in planning their families.

Take out a coin and announce that heads means a girl and tails means a boy. Ask one student to flip the coin to determine the sex of his or her first child. After seeing whether the child is a boy or a girl, the student must decide whether to flip again (have another child) or stop. Continue this process until the student's

Continued on following page

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"family" is complete. Then record the total number of children the student "had," and invite the next student to flip the coin.

A fun way of recording the frequency of students' completed "family sizes" is to have them build a bar graph using stick-on dots and butcher paper. Label the horizontal axis, "Number of Children," and the vertical axis, "Number of Responses." As students finish their turns, have them each place a stick-on dot over the number of children they "had" so that they build vertical columns of dots.

When everyone has had a turn, ask students to calculate the average number of children the class "had." Compare this figure with the average number of children students originally said they wanted to have (question #3 in Activity One). Chances are the average number of "actual" children will be higher than the original average number of "desired" children.

Discussion Questions for Extended Learning:

1. What factors, besides income, determine how many children people have?
2. Why might a boy child or a girl child be preferred?
3. How might this preference vary from one culture to another?
4. What difference does it make to a society whether there is a tradition of large families or a tradition of small families?
5. How do your personal family-size decisions affect other people in the society?
6. How do your personal family-size decisions affect the natural environment?

*Adapted with permission from Carolynn S. Howell, Palm Bay High School, Melbourne, Florida 32901.

Student Worksheet

FAMILY PERSPECTIVE: CALCULATING FAMILY-SIZE TRENDS

1. Generation 1

   You may substitute a guardian or other adult relative for mother or father as you answer these questions if you wish.

   a) My mother's parents had _____ children, including my mother.

   b) My father's parents had _____ children, including my father.

   c) The average number of children in my two parents' families (Generation 1) is _____. (Don't worry if the number includes a fraction or decimal place.)

2. Generation 2

   My parents have _____ children, including me.

3. Generation 3

   I would like to have _____ children when I grow up, assuming I have a job and my life is in pretty good shape.

4. Is there a family-size trend in your family? (Is the number of children getting larger, getting smaller, holding steady?) Describe what you see. _____

   _____

5. How does the family-size trend in your family compare with the trend in the larger "society" composed of your classmates' families? _____

   _____

Extra Credit Project: Gather this kind of data for 50 different persons. Prepare a presentation about family-size trends in this sample population, either on poster board or as a report.

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FOR THE COMMON GOOD

Concept: Sustaining our natural resource base requires conservation and the cooperative use of resources held in common.

Objectives:

- In a simulation, students desiring to draw renewable resources from a common pool determine short-term consumption strategies that will preserve a long-term supply of the resource.
- After participating in a game, students discuss the ethical dilemma created when one must choose between maximizing individual gain and maximizing the common good.

Subject Areas: Social Studies, Science

Activity One: Something for Everyone*

Materials:

Cardboard or plastic chips approximately 1" in diameter: about 10 chips per student should be available altogether
Candies, decals, or something the students value highly
Stopwatch or watch with a second hand
Record or tape player for playing music
Record or tape of lively music (at least 8 minutes of continuously playing music)

Procedure:

The students sit in a circle (or two circles if there are more than 15 students). In the center of the circle, at least 3 feet away from the closest students, place one-fourth of the chips. (For example, if you have 10 students, you use 100 chips and begin with 25 in the center of the circle). Read the following rules carefully to the students. Allow time for questions and answers to make sure students understand the rules of the game thoroughly.

Rules

1. The chips belong to all of you.
2. Music will be played, and while it is playing, everybody may take chips out of the pool of chips in the center.
3. You may trade in 10 chips for a piece of candy (or decal).
4. As soon as the music stops, I will double the number of chips left in the pool at that time, and then continue the game.
5. There will never, however, be more chips in the pool than there are at the start of the game; this is the maximum number of chips the pool can hold.
6. You may not talk to anyone during the game.

Notes to the Leader

- The length of time that spans between doubling the pool can be varied, but should be consistent within each game. Try 30 seconds to 1 minute to begin with.
- The number of chips after doubling should not exceed the initial number in the pool (its "carrying capacity").

In all likelihood, the pool will be depleted before the music stops. Repeat the game two times without giving the students time to communicate with one another in between.

After that, collect information about what happened and have students report on their feelings (see discussion questions below). Generate, as a group, cooperative strategies that could ensure more students accumulate 10 chips and still leave the pool largely undisturbed. Play again using these strategies developed by the students.

Follow-up Discussion for Extended Learning:

1. How long did it take in every game until the pool was depleted? (Have one student or onlooker take notes.)
2. How many chips were taken out of the pool in each of the different game variations? How many candies (or other rewards) did this generate?
3. How did talking about the game make you play differently? How did it make you feel about other members of the group?

Continued on following page

4. Did you feel like you had different reasons for playing the game after talking about strategies? Do you think other participants had different motivations for taking the chips? How did this make you feel?
5. Have you experienced a similar situation at home, with friends, or in your community? (The teacher may wish to provide an experience of his or her own to help students see the similarities.)
6. Discuss how, in the long run, more can benefit if the individual refrains from taking too much, and what attitude is needed among the individual members to achieve the goal of the greatest benefit for all.
7. Make a parallel between the chips and candies, and a forest and tree usage (for paper and wood products).
8. Discuss similarities with other renewable resources and their use or overuse by individuals (e.g., depletion of clean air and water, overuse of land, worldwide food consumption).

Activity Two: A Social Dilemma**

Materials:

Paper and pencils or pens

Procedure:

Instruct students as follows: "Let's play a game as a class. Each of you writes down a C or D on a piece of paper without showing it to anyone else. You cannot see what anyone writes. Now, here's the deal. If you write a C, I give you nothing, but I give *everyone else* in the class $1 (in pretend money). If you write D, I give you $2, but I give everyone else nothing. I'll do this for everyone in the class, so you'll get however many dollars you give yourself plus however many dollars everybody else gives you.

Make sure students understand the payoff scheme: they get $1 for everyone else in the class who writes C, plus $2 if *they themselves* write D. Then give them a short time to write down on their papers what they would choose, C or D.

Say, "Now, before you tell what you did, let's look at it another way. If everybody puts down a C, you get a dollar for everybody in the class except you. That's how many dollars? If everyone puts down a D, everybody gets $2. Now try again."

Give students time to reconsider and change their answers if they so choose. Then ask everyone to reveal their final choices, whether they changed, and why.

Teacher's Notes

This type of situation is called a social dilemma. Everyone does best if all *cooperate* (the C option), but each gets a little more money by acting selfishly, or *defecting* (choosing D). It is a common situation. The C response is analogous to contributing to public TV, not trying to evade the law, keeping promises, doing one's job whole-heartedly in the absence of supervision, not taking more than one's share of a public resource, not polluting the air and not having too many children. The D response corresponds to the opposite choice in each case. Students who understand the theory of social dilemmas will be better able to understand the need for solutions to them.

Follow-up Discussion for Extended Learning:

1. C is called *cooperating* and D is *defecting*. How would you feel if you cooperated and everyone else defected?
2. How would you feel if you defected and everyone else cooperated?
3. In this game, when do all the participants get the most? The least?
4. What are some examples of C-type (cooperative) behavior in the real world?
5. Think of a real-life social dilemma in which too few people cooperate. How could people be encouraged to cooperate more?

*Adapted from an activity developed by Kurt and Ursula Frischknecht and Karen Zimbelman in *Thinking Globally and Acting Locally: Environmental Education Teaching Activities* by Lori D. Mann and William B. Stapp, ERIC/SMEAC, 1982.

**Adapted with permission from an activity developed by Jonathan Baron, Decision Science Consortium, Inc., Reston, Virginia, 1988.

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HUMAN MASSES, GREENHOUSE GASES

Concept: The more people there are on Earth, and the more fossil fuels they consume, the greater are the accumulations of gases that aggravate the greenhouse effect.

Objectives:

- Students calculate the amount of carbon dioxide released by automobiles in the U.S. and in the world each year and determine the amount of forest land needed to absorb these levels of carbon dioxide.
- Students calculate one family's production of carbon dioxide in a year and determine how much forest land is needed to absorb this amount of carbon dioxide.

Subject Areas: Science, Math

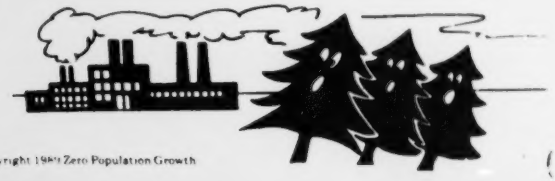
Materials:

Student worksheets (one per student)
Calculators (optional)
Pencils or pens and scrap paper for calculations
Graph paper, straight edge and sharp pencils of two colors

Introduction:

As more and more people come to live on the Earth and energy use continues to increase, we are putting more and more carbon dioxide, methane and other gases into the atmosphere. These gases intensify the greenhouse effect, making the Earth's climate gradually warmer and warmer.

Since the Industrial Revolution, the concentration of CO_2 in the atmosphere has increased by more than 25 percent. In just the last 30 years, it has increased by 9 percent. Both the exponential growth in human numbers and the increasing consumption of energy per capita are contributing to this dangerous trend.



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Procedure:

Duplicate the student worksheet at the end of this activity so that there are enough for each student to have one. Then have students complete the exercises on the worksheet, working individually or in small groups. Follow up with the activity, "Global Warming Begins at Home," done as a class. Then lead a class discussion guided by the following questions:

1. What kinds of human activity contribute to the greenhouse effect?
2. Planting trees can help combat global warming, but the single best way for people to reduce their impact on the climate is to cut down on the amount of carbon dioxide they produce through the use of fossil fuels. What are some specific ways a person can reduce his or her use of fossil fuels? (Note: Many possible answers may be found in *Making a Difference*, included in this teaching kit.)

Answers to Student Worksheet Questions:

1. Walking, bicycle, public transportation systems (e.g., buses, electrically-powered trains, cable cars)
2. a) 600,000,000 tons
   b) 230,769,000 acres. This is approximately equal to the the land area of the entire National Forest System of the United States.
   c) 3,529,412,000 tons
   d) 1,357,466,000 acres
   e) 2,121,000 square miles. This is approximately equal to the combined land area of all the United States west of the Mississippi River except Alaska and Hawaii.
   f) 8,461,538,000 acres
   g) 13,221,000 square miles. This is approximately equal to the area of the Western Hemisphere minus Brazil.

Continued on following page

Activity: Global Warming Begins at Home*

1. Calculate approximately how much carbon dioxide one family's activity adds to the atmosphere in a year. (Ask for a student or parent volunteer to provide the data needed for the classroom activity from their household records. Alternatively, use data from your own household or that of someone not associated with your class.) Use the following guidelines:

   a) Find out how many miles the family drove in the past year and how many miles per gallon of gasoline the family car gets. (If there is more than one car, get these figures for each car.) Divide the miles driven by the miles per gallon to calculate how many gallons of gasoline the family car(s) burned during the year. Each gallon burned produces 20 pounds of CO_2.

   b) Find out from the local power company how the power plant generates the family's electricity (e.g., whether it is coal-fired, uses hydropower or nuclear energy). On utility bills, look up how many kilowatt-hours of electricity were used in the home in a year. Each kilowatt-hour of electricity generated in a coal-fired power plant produces two pounds of CO_2. (Hydropower and nuclear energy are CO_2-free.)

   c) Look up how much natural gas was used in the home in the past year. Burning a hundred cubic feet of natural gas (1 ccf) produces 12 pounds of CO_2. (1 ccf is equal to 1 therm or 100,000 BTUs.)

   d) Estimate how many miles family members flew on trips taken for business or pleasure in the past year. Flying one mile in an airplane generates approximately one-half pound of CO_2 per passenger.

   e) Add the total amounts of CO_2 in a)—d) above to calculate the family's direct production of CO_2. Then double that figure to account for the CO_2 produced indirectly through the purchase of goods and services. (Carbon dioxide is used in the production of many items you buy, in the heating and cooling of public buildings you use, etc.)

2. One forest tree absorbs 13 pounds of carbon dioxide each year; one acre of trees absorbs 2.6 tons of carbon dioxide each year. How many trees would be needed to absorb all this CO_2? How many acres of trees?

Extension Activity:

Get your students involved in a tree planting project around your school or community. Such an activity might be especially appropriate around Arbor Day. The National Arbor Day Foundation at 100 Arbor Avenue, Nebraska City, NE 68410 can tell you when Arbor Day will be celebrated in your state. Contact the American Forestry Association (P.O. Box 2000, Washington, D.C. 20013) to receive further ideas on how to show students the connections between tree planting and reducing global warming. Ask for their free *Global ReLeaf* kit.

*Adapted with permission from James R. Udall, "Domestic Calculations: Adding Up the CO_2 You Spew," *Sierra*, July/August 1989.

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CORRECTION SHEET

HUMAN MASSES, GREENHOUSE GASES

Activity: Global Warming Begins at Home

Please take note of the following change:

1. b) . . . Each kilowatt-hour of electricity generated in a coal-fired power plant produces **three** pounds of CO_2.

We regret that the following three questions were accidentally omitted from the bottom of the student worksheet portion of "Human Masses, Greenhouse Gases." Please add the portion below when copying the student worksheet for the class. Answers appear on the teacher's section of the activity.

---

e) If 640 acres = 1 square mile, how many square miles of forest would you need to absorb all the CO_2 released in the U.S.? (Round to the nearest 1000.)
_____ square miles.

f) Worldwide, annual CO_2 emissions equal about 22 billion tons (22,000,000,000). How many acres of trees would you need to absorb all this CO_2? (Round to the nearest 1000.)
_____ acres.

g) How many square miles of trees would you need? (Round to the nearest 1000.) _____ square miles.

HUMAN MASSES, GREENHOUSE GASES
Student Worksheet

Certain kinds of human activity generate gases that form a layer around the Earth, trapping the sun's heat so that it cannot escape back into space. The trapped heat creates a "greenhouse effect," keeping the Earth warm enough for life to exist. If too many "greenhouse gases" are put into the atmosphere, however, it may gradually get warmer and warmer. This may cause serious climate changes throughout the world, such as droughts in farm areas. Many scientists believe this global warming has already begun.

1. Carbon dioxide (CO_2) is one of the primary gases which causes the "greenhouse effect." When gasoline is burned, carbon dioxide is released into the air. Worldwide, the production and use of automobiles account for 17% of all the carbon dioxide released from fossil fuels. Which types of transportation might release less carbon dioxide per person?

   _____

   _____

2. Trees use carbon dioxide as they grow, and they produce oxygen for people to breathe. They help keep the Earth cool by cutting down on the amount of CO_2 in the air. In an industrial society where more and more fossil fuels are burned each year, producing more and more carbon dioxide, trees are vital to the health of our planet.

   a) Driving one mile releases approximately one pound of CO_2 into the air, on the average. If Americans drive a total of 1.2 trillion (1,200,000,000,000) miles each year, how many tons of CO_2 do cars release each year? (Note: There are 2,000 pounds in a ton.) _____ tons.

   b) One forest tree absorbs 13 pounds of carbon dioxide each year; one acre of trees absorbs 2.6 tons of carbon dioxide each year. How many acres of trees would be needed to absorb all this CO_2? (Round to the nearest 1000.) _____ acres.

   c) Only 17% of the CO_2 which is released from burning fossil fuels comes from automobiles. How much total CO_2 is released from burning fossil fuels each year? (Round to the nearest 1000.) _____ tons.

   d) How many acres of trees would be needed to absorb all of this CO_2? (Round to the nearest 1000.) _____ acres.

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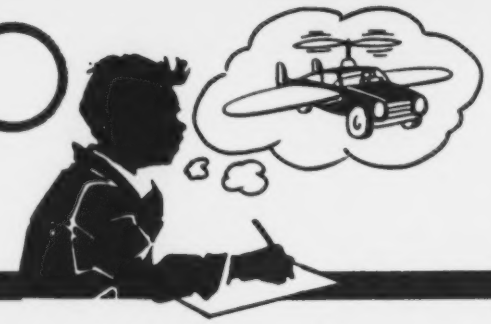
LOOKING TO THE FUTURE



Concept: Human behavior today will affect the quality of life in the future.

Objective:

- Before and after study, students identify personal goals to be achieved in 20 years.
- Students discuss potential impacts of current population trends on their own future lives.
- Students collect and summarize news articles about population and environmental trends.

Subject Areas: Science, Social Studies, Language Arts, Family Life

Materials:

Paper and pen or pencil for each student

Activity One: My Hopes for the Future*

Introduction:

It is valuable for students to think about what is possible, probable and preferable in their future lives. This activity is an excellent way to encourage futuristic thinking and also to determine whether students' thinking has changed as a result of what has been studied in class.

Procedure:

During the first month of the school year, or at the beginning of an ecology unit, ask students to write 10 things they would like to have, to be, or to have done 20 years from now. Collect their responses and, as a class, tally the results. How many want to be wealthy? How many would like to have children, a career, etc.?

At the end of the school year (or unit), repeat the exercise, and again tally the results for the class. How do the results compare? In what ways do they differ?

Activity Two: News and Views

Introduction:

Students can only make educated guesses about what might happen in the future if they are aware of what is happening in the present. Challenging students to find news articles relevant to topics you cover in class has the added advantage of encouraging them to get in the habit of reading the newspaper.

Procedure:

1. Have students collect news articles and opinion pieces on human population trends and interrelated environmental and social issues. You may assign each student a few specific subjects or have all students looking for all subjects. The subjects may include, but are not limited to, the following:

   Air pollution
   Endangered species
   Food resources/hunger
   Greenhouse effect/global climate change
   Housing and homelessness
   Immigration and emigration
   Loss of forests
   Mothers' and infants' health
   Population growth
   Population loss
   Social security
   Soil erosion
   Waste disposal
   Water pollution

   Have students assemble a weekly "newsbriefs" bulletin board and/or a monthly newsletter summarizing population and environmental news. To facilitate the summarizing approach, students should write a one- or two-sentence summary of each article they bring in and submit it along with the article.

2. Tell students to pretend they are working in a newsroom 40-50 years in the future. Have them prepare a news telecast which includes

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news stories from the United States and around the world related to population and environmental trends. This assignment may be done individually or in small groups. If possible, videotape students' telecasts and "air" them for the class.

Activity Three: Dear Friend

Introduction:

This creative writing exercise invites students to consider how continuing human population growth could affect their own lives in the future.

Procedure:

Duplicate the assignment sheet on the back of this page and distribute it to students. You may wish to suggest how long their letters should be.

*Developed by Garland Johnson, Fresno Unified School District, Fresno, California.

DEAR FRIEND
Assignment Sheet

If current rates of growth continue, the world's population will double in approximately 40 years. Think about what this means for your own life. What might you be doing in 40 years? How might it affect your life if there are twice as many people in the world?

Write a letter, dated 40 years from today, to an old friend you haven't seen in many years, perhaps someone you are friendly with now. Talk about what is happening in your life and reflect on how things have changed in 40 years.

Think about your neighborhood and other places you like to go. How have they changed? How do people get around? What kind of work do you do? How has your lifestyle changed since you last saw your friend?

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MEASURING A MILLION

Concept: Millions and billions of people are huge numbers.

Objective: In small groups, students work on one of the four problems below to appreciate what is meant by a million and a billion.

Subject Areas: Math, Science

Introduction:

There are currently over five billion people living on Earth. Students often have difficulty understanding what is meant by such a staggering figure. The following cooperative learning activities allow students to represent a million of various objects through mathematical computation. You can also take these exercises one step further by having students visualize and compute formulas for one billion of each object (See Extension Ideas).

Materials:

4 yard/meter sticks
1 ping pong ball
50 sheets of paper
50 sheets of cardstock
Map of the United States

Procedure:

Divide the class into four groups. Each group will be responsible for doing one of the following four activities, using the student worksheets to guide them. When the activities are finished, have each group present their methods and findings to the other students, who take notes on the presentations.

Group #1: How many ping pong balls would fit in the classroom? How big a room do you need to hold a million ping pong balls?

Group #2: How tall would a million sheets of paper be? What if the paper were cardstock?

Group #3: If you take a million steps, starting from the door of the room, where will you be?

Group #4: Imagine a crowd of one million people. How big a field do you think you would need to contain all of them? If they were marching down the road in single file, how long do you think the column of marchers would be?

Extended Learning:

1. Now that students have a better idea of what is meant by a million, have them take their findings one step further for a billion (1,000 x one million) of each item (ping pong balls, sheets of paper, steps, people).
2. There are over five billion people in the world. What would be the length of a row of five billion people?
3. Millions and billions can also be used for solving time problems. Will you be living a million hours from now? How about a billion minutes from now? How old is a person who has lived a million seconds? A billion seconds?

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MEASURING A MILLION
Student Worksheet — Group #1

Problem: A) How many ping pong balls would fit in the classroom?
B) How big a room do you need to hold a million ping pong balls?

Process:

1. I would estimate that _____ ping pong balls fit in the room.
2. The average estimate of all those in my group is _____.
3. The diameter of one ping pong ball is _____
4. The length of the room is _____. The width of the room is _____. The height of the room is _____.
5. a) You would need _____ (amount) ping pong balls to make a line the length of the room?
   b) You would need _____ ping pong balls to make a line the width of the room.
   c) You would need _____ ping pong balls to make a line the height of the room.
   d) The dimensions of the room in ping pong balls are _____ x _____ x _____.
6. The volume of a room can be calculated by multiplying the length, width and height together (V=lwh). Therefore, the volume of the room, in terms of ping pong balls, is _____ balls.
7. Write out your plan and calculations for determining the size of a room that will hold a million ping pong balls.

Student Worksheet — Group #2

Problem: A) How tall would a stack of a million sheets of paper be?
B) How tall would the stack be if the paper were cardstock?

Process:

1. I would estimate that the height of a stack of a million sheets of paper would be _____ centimeters.
2. The average estimate for my group is _____ centimeters.

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3. The height of 25 sheets of paper is _____ mm or _____ cm. The height of 50 sheets of paper is _____ mm or _____ cm.
4. Based on the information in #3, the height of 100 sheets of paper would be _____ mm or _____ cm.
5. Based on the information in #4, the height of 1,000,000 sheets of paper is _____ mm or _____ cm or _____ meters.
6. How would the height change if the paper were cardstock?

   _____.
7. Use the same procedure for cardstock as in #3 and #4. The height of 1,000,000 sheets of cardstock is _____ mm or _____ cm or _____ meters.
8. If each story of a building is 3 meters high, how many stories would be in the building if its height is the same as that of a million sheets of cardstock? _____. Can you think of a building which is about that high? _____.

Student Worksheet — Group #3

Problem: ***If you take a million steps, starting from the door of the room, where will you be?***

Process:

1. In which direction do you plan to travel? _____.
2. Where do you estimate you will be after taking a million steps in this direction? _____. The average estimate for my group is _____.
3. When I take 10 steps, the average distance traveled is _____. The average distance traveled for each member of my group is _____.
4. Knowing that 10 steps = _____ feet, you can set up a proportion to find how many feet equal 1,000,000 steps.

$$\frac{10 \text{ steps}}{___ \text{ feet}} = \frac{1{,}000{,}000 \text{ steps}}{x \text{ feet}}$$

   Cross-multiply to solve for x.
   x = _____ feet.
5. If 1 mile = 5,280 feet, how many miles equal a million steps? _____ miles.
6. Look at a map of your area. Where would you be after traveling a million steps north? _____. A million steps south? _____. East? _____. West? _____.

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Student Worksheet — Group #4

Problem: ***A) Imagine a crowd of one million people. How big a field do you think you would need to contain all of them?***

B) If they were marching down the road, how long do you think the single-file row of marchers would be?

Process:

1. If an acre is about the size of a football field, you would probably need _____ acres to contain one million people. (estimate)
2. The average estimate for my group is _____ acres.
3. Have four students in your group stand together in a cluster. Mark the space around them with chalk on the floor and measure the space in square centimeters. Convert this to square meters. Ask four more to stand in that space. Does the area need to be enlarged? _____.
4. Set up a ratio of people to area to find how many square meters are needed for a million people.

$$\frac{\text{4 people}}{\text{____ sq. meters}} = \frac{\text{1,000,000 people}}{\text{x sq. meters}}$$

   Cross multiply to solve for x.

5. If 1 acre=4,047 square meters, about how many acres would you need to contain one million people? _____. Can you think of an area in your community which is about this size? _____.
6. Measure the length of four people standing one behind the other in a row. The length is _____ centimeters or _____ meters. The ratio of people to length is _____:_____.

$$\frac{\text{4 people}}{\text{____ meters}} = \frac{\text{1,000,000 people}}{\text{x meters}}$$

   Cross multiply to solve for x.

7. How many kilometers long would the line of people be? (1 kilometer = 1,000 meters) _____ km. How many miles long is this? (1 mile = 1.6 kilometers) _____ miles.
8. Look at a map of your state or country. Can you find a distance between two cities which is equivalent to the length of the row of a million people? _____ _____.

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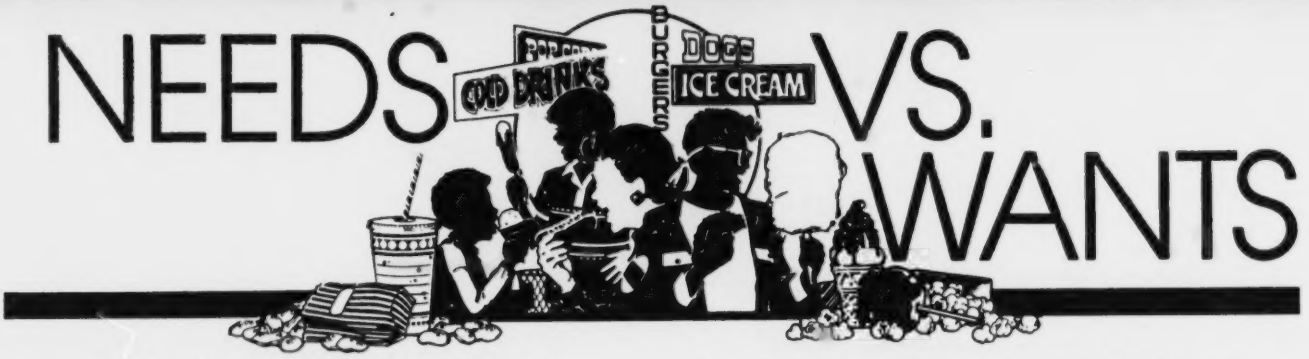
NEEDS VS. WANTS



Concept: Continued population growth will force us to reevaluate our consumption patterns, perhaps causing us to sacrifice some of our luxuries to accommodate others.

Objective:

- Students determine which resources are used in making various household goods and luxuries.
- Students decide which luxuries they will forego to allow growing numbers of people to have the basic necessities for survival.

Subject Areas: Science, Social Studies

Introduction:

Because of the way we live, each American has a far greater impact on the environment than a person from any other country. In energy use alone, the average American uses the equivalent of 45 barrels of oil per year, as compared to three barrels of oil per year for the average Chinese or one barrel for the average Indian. Much of the world's energy is wasted, especially when used for luxuries for a few people instead of necessities for many. As an increasing number of people place higher demands on energy resources, shortages are going to become more serious.

Materials: Paper and pencil

Procedure:

1. Instruct students to draw a line lengthwise down the middle of a sheet of paper.
2. On the left side, they will list the basic needs of every human being: water, food, clothing, shelter, etc.
3. On the right, they will list the things they need or want for their own lifestyles: color-TV, stereo, VCR, car, hot water, McDonald's hamburgers, etc. Next to each item, they should name some of the resources or products needed to produce these things: oil, electricity, iron, pesticides, grain, water, etc.
4. Tell them to cross off three of the items on the right side so that people who now lack the basic necessities on the left side can survive.
5. Tell them to cross off three more items from the right, since continued population growth and development will mean giving up such levels of consumption.
6. How many more items, if any, are they willing to cross off their lists to sustain population growth as well as rising consumption in the U.S and the rest of the world? What values, if any, are in conflict?

Basic Necessities	My Needs or Wants
food	stereo (wood, oil, water, electricity)
water	T.V. (metal, oil, electricity, glass)
clothing	McDonald's hamburger (grain, pesticide, oil, fertilizer, wood)
shelter	hot water (water, oil or gas, copper, lead iron)
. . .	

Extended Learning:

1. For homework, have students make lists of everything in their homes which is powered by oil, gas and electricity. How many of these items would they be willing to live without?
2. Have students imagine they survive a plane crash with four or five others on a deserted, temperate island, with no hope of being found. They should describe the essentials they need to survive. Have them compare this lifestyle with the way they currently live, listing the excesses that are not necessary for survival. Or, have students research typical lifestyles in different developing countries and compare them with their own.

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ON THE DOUBLE

Concept: When birth rates are significantly higher than death rates, the population grows quickly. The greater the difference, the faster it grows.

Objective: Students will calculate the rate of natural increase for several countries, as well as their corresponding population doubling times. Through this activity, they will learn how natural increase translates into actual numbers of people being added to the total population.

Subject Areas: Math, Science, Social Studies

Introduction:

The annual population increase throughout the world is currently 1.8%. While this number may sound small, today's population will double in just 39 years if we continue to grow at this rate. It is interesting to note the difference in various countries' doubling times. At current rates, many countries will double their populations in less than 20 years, while others have reached zero population growth (z.p.g.) and do not expect to grow at all.

Materials:

Paper
Pencil or pen
Calculator (optional)
*World Population Data Sheet** (included in this teaching kit)

Procedure:

1. Explain to students that the larger the difference between a nation's birth rate and its death rate, the greater the increase in population growth. Ask them to look at the chart on the back of this page and determine which country will have have the highest rate of increase? The lowest? (Answers: Kenya; West Germany)

2. Now have students determine the rate of annual increase for each country's population, using the following formula:

$$\%\ \text{annual increase} = \frac{\text{birth rate} - \text{death rate}}{10}$$

For example, the world's annual population increase in 1989 can be calculated, knowing that the birth rate is 28 births/1,000 people and the death rate is 10 deaths/1,000 people:

$$28 - 10 = 18 \text{ per } 1{,}000$$

$$\frac{18}{10} = 1.8\% \text{ (1.8 per 100)}$$

(Answers in percents: 0.7; 2.4; 0.5; 0.3; 1.4; 2.2; 4.1; 1; 2.6; 0.1; 0)

(Note: Immigration and emigration also affect a country's annual population increase. For example, the annual population increase in the U.S. is actually 0.9% if net immigration is included.)

3. Based on the rate of increase, students can now determine each country's population doubling time with the following formula:

$$\text{doubling time (in years)} = \frac{70}{\text{rate of increase}}$$

(Note: 70 is the approximate equivalent of 100 times the natural logarithm of 2.)

Continued on back page

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4. Refer to birth rates and death rates listed in the *World Population Data Sheet* included in the kit to calculate doubling times for any other countries not listed on the table on this page. Give students the current populations for the countries listed below and let them determine the populations once they have doubled.

Country	Birth Rate in 1989 (per 1,000 people)	Death Rate in 1989 (per 1,000 people)
United States	16	9
Mexico	30	6
Japan	11	6
United Kingdom	14	11
China	21	7
India	33	11
Kenya	54	13
U.S.S.R.	20	10
South Africa	35	9
Italy	10	9
West Germany	11	11

Discussion:

1. Why do you think some countries are doubling much more rapidly than others? Why do you think some countries, such as West Germany, reached zero population growth?
2. Which figures differ most greatly between countries, the birth rates or the death rates? How would you explain the wide disparity in birth rates among different countries?
3. If you were a national leader in Kenya, would you be concerned about the rapid population growth? Why or why not? Similarly, if you were a national leader in West Germany, would you be concerned that your country had reached z.p.g.? Why or why not?

Extended Learning:

Have students make a list of possible environmental, social and economic consequences of living in a country where the population increases as quickly as it is in Kenya, Mexico or South Africa. Divide the class into groups and have each group research living conditions in a different developing country which is experiencing rapid population growth. Students could use the resources in their school or community library. Each group should then present their findings to the class.

*Note: *World Population Data Sheet* is published annually by the Population Reference Bureau. To order an updated edition, contact: PRB, 777 Fourteenth Street N.W., Suite 800, Washington, D.C. 20005, (202) 639-8040.

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POPULATION CIRCLE

Concept: Populations grow exponentially, not arithmetically.

Objective: Students simulate the history and future of world population growth as they demonstrate exponential growth within a circle.

Subject Areas: Math, Science, Social Studies

Introduction:

Many social scientists have referred to population growth over the last century as a population explosion because the numbers of people have grown exponentially. The following activity demonstrates this concept.

Materials:

Chalk
Bell or gong
Stopwatch or watch with a second hand

Procedure:

1. Draw a chalk circle on the floor about six feet in diameter. Yarn or tape may also be used to mark off the circle.
2. Ask two students to stand in the circle to represent the world's population in the year 1500, and have more students enter the circle according to the table on this page. (Note: If you don't want to wait four minutes, 10 seconds for the first interval, you could begin the simulation in the year 1750 with three people in the circle).
3. Each student represents 250 million people (approx. the U.S. population in 1990). Each second represents one year. If there are more than 20 students, make each student represent fewer people. For example, if one student equals 100 million people, you would need about 50 students.
4. One person should be responsible for informing the group about the passage of years, the world population in numbers and the intervals in years. Be dramatic! Use a bell or gong for each new time span.

Year	World Population (in millions)	Total in Circle (if 1=250 million)	Interval To Next Date	Add Participants at end of this Simulation interval	Add to Circle
1500	500	2	250 yrs.	4 mins., 10 secs.	1
1750	750	3	100	1 min., 40 secs.	1
1850	1,000	4	50	50 secs.	2
1900	1,500	6	25	25 secs.	2
1925	2,000	8	24	24 secs.	2
1949	2,500	10	13	13 secs.	2
1962	3,000	12	13	13 secs.	2
1975	4,000	16	13	13 secs.	4
1987	5,000	20	12	12 secs.	4

Extended Learning:

1. Using the table on this page, have students plot population growth from 1500 to 1987 on a coordinate graph to see the resulting J-curve.
2. Watch the dramatic, four-minute film, *World Population*, which displays this concept of exponential population growth throughout the world's history. For information on renting or purchasing this film, see the resource list included in this kit.
3. Help students understand the concepts of exponential and arithmetic growth by using the math exercise below:

   If you have $100 and add $10 to it the first year and each successive year, how much money would you have after 10 years? After 20 years? This is arithmetic growth — growth that results from increases of a uniform amount during a series of equal time periods. If you invest your initial $100 at a rate of interest of 10 percent, each increment would be based on the original amount plus all previously added interest — an ever-increasing base. If you invested your $100 at a 10 percent rate of interest, how much money would you have after 10 years? After 20 years? This is exponential growth. Because the base population is always increasing, population grows exponentially.

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SHARE THE WEALTH

Concept: Decisions about resource distribution involve ethical dilemmas when the demand for resources is greater than the supply.

Objective: Students decide how to distribute limited resources, given conflicting demands from four hypothetical groups needing resources to survive or improve their quality of life.

Subject Areas: Social Studies, Science

Materials:

One worksheet per student (duplicated from master on other side of this page)
One pen or pencil per student
Optional: Large sheets of paper and markers, one per student group, to record group's decisions

Introduction:

As population increases and the disparity between rich nations and poor nations also increases, decisions have to be made about the distribution of resources. Affluent nations must evaluate their use of resources while developing nations must strive to become more self-sufficient. All the while, resources are being depleted.

Decisions concerning resource distribution are related to the availability of the resource, but also to a country's social, political and economic conditions. Both science and social studies, therefore, may incorporate lessons on this subject.

Procedure:

1. Give each student a worksheet and instruct them to complete the "Individual Decisions" section individually.
2. After all students have made their decisions, divide them into groups of four or five. Instruct students to now assume that it is their *group* that has 300 units of resources, rather than each individual. Each group must now try to reach consensus about distributing its resources.
3. You may want to have each group choose one member to assume the role of recorder and another to serve as reporter. The recorder writes down the group's decisions as they are made, and the reporter presents them later to the full class. You may also want to give them a time limit, perhaps 20 minutes, to reach their decisions. Answer any questions the students may have about procedures before they begin.
4. While groups are working, circulate among them to answer questions that may arise. Note that the information given in the worksheet is all the students have to go on. If students want more information, tell them to make a note of the information they wish they had, to use in the discussion that will follow.
5. When time is up, have each group present their decisions and give the reasons for distributing resources as they did. Then lead a discussion about how the decisions were made:
   - On what did they base their decisions?
   - What other information would they have requested?
   - Would they change their decisions if more units of resources were available?
   - Would they be willing to change their lifestyle in order to make more units of resources available for distribution?

Discussion Questions for Extended Learning:

1. What are some resources that our country exports to others? Are any essential for people's survival in other countries?
2. What are some resources that our country must import from others? Are any essential for people's survival in our country? Are any essential to maintain our current quality of life?

*Adapted with permission from "Distributing Resources" in *Becoming a Secondary School Science Teacher* by Leslie Trowbridge and Rodger W. Bybee, Merrill Publishing Company, Columbus, Ohio, 1986.

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SHARE THE WEALTH
Student Worksheet

Your problem is to decide how to distribute resources among four groups who have requested your help. For this activity, we are using the term "resources" to include many different things needed by people, such as food, minerals, fuels and other items. Here is the only information you have to make your decisions:

You have 300 units of resources.
You presently use 200 units of resources.
You can survive on 100 units of resources.

These groups want some of your resources. Here are their situations:

Group 1—needs 250 units of resources to survive
wants 250 units of resources

Group 2—needs 100 units of resources to survive
wants 200 units for survival and improvement

Group 3—needs 50 units for survival
wants 100 units for survival and improvement

Group 4—needs no units for survival
wants 200 units for survival and improvement

You must decide how you will distribute the resources you have. Complete the chart below. As you make your decisions, remember to consider your own needs too.

INDIVIDUAL DECISIONS

	Group 1	Group 2	Group 3	Group 4
Distribution of Resources				
Reasons for Decision				

Now work with the group to which you have been assigned and try to reach agreement on how the group would distribute its 300 resources.

GROUP DECISIONS

	Group 1	Group 2	Group 3	Group 4
Distribution of Resources				
Reasons for Decision				

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SHOPPERS' CHOICES CONSUMERS' VOICES

Concept: Individuals can reduce environmental stress and the depletion of natural resources through decisions they make as consumers.

Objective: Students identify ways an individual can contribute to a sustainable balance of population, resources and environment through choices one makes as a consumer.

Subject Areas: Science, Math, Social Studies

Materials:

Paper and pen or pencil
Calculator (optional)

Introduction:

Many people do not realize how much they, as individual consumers, contribute to trends in resource use and environmental damage. Each time a shopper selects one particular item rather than another in the supermarket, that choice tells manufacturers and retailers something about what people will accept. Each time a person buys anything, another one of those things will probably be produced to replace it on the shelf, using more resources and generating more waste in the course of its production.

What one buys, then, and how much one buys, affects what is produced and sold and how it is packaged. Individuals can encourage fuel-efficiency, clean (non-polluting) production and minimal generation of solid waste through the choices they make in the everyday act of grocery shopping.

Procedure:

Take a class field trip to the supermarket, or assign these activities as homework. In either case, allow students to work in small groups, with one activity assigned to each group. Then have the small groups report their conclusions to the rest of the class, while all other students take notes. To conclude the unit, have the class answer the following question:

> What are some specific things an individual can do to help conserve resources and protect the environment? (Think about specific choices a consumer can make.)

Some possible answers suggested by the students' supermarket challenges are:

- Request paper bags rather than plastic ones, or bring your own bags to avoid using new ones.
- Buy items with as little packaging as possible. Choose paper packaging over plastic.
- Buy reusable products rather than disposable ones.
- Reuse or recycle packaging items as much as possible.
- Drive to the supermarket less frequently, buying more supplies at a time, rather than driving more frequently to buy only a few items at a time.

This activity adapted with permission from "Some City Science Challenges" by William C. Ritz.

SHOPPERS' CHOICES, CONSUMERS' VOICES
Student Activities

Pop Shop

In the beverage section of the supermarket, compare various packagings of the same soda (that is, cans vs. no-return bottles vs. returnable bottles, as well as containers of different volumes).

1. Which one is the "best buy"? State the cost of each, per unit of volume, to support your conclusion.
2. Which one produces the least amount of after-use solid waste to dispose of? State how each type of packaging can be best disposed of, in the interest of environmental protection and resource conservation.

Package Baggage

In the supermarket, find one kind of *non-beverage* product that is packaged in different ways. Compare the different packaging formats:

1. Which one is the "best buy"? State the cost of each, per unit of volume, to support your conclusion.
2. Which one produces the least amount of after-use solid waste to dispose of? State how each type of packaging can be best disposed of, in the interest of environmental protection and resource conservation.

Continued on back page

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Bag Drag

1. Watch people who are leaving the supermarket. What proportion of people leave the supermarket with two or more bags? For what proportion of shoppers would a bag not be necessary?
2. Find out what bags cost the store. Who pays for them?
3. If the store offers both paper and plastic bags, what proportion of shoppers choose each type of bag?
4. How do you "get rid of" a bag once it has been used? Where does it go? What happens to it next? Which type of shopping bag — paper or plastic — can be disposed up with the least harm to the environment?
5. How might paper shopping bags be reused? Plastic ones? Can you think of a way a person could cut down on the use of disposable shopping bags? How could you avoid using them altogether?

Size Wise

1. Randomly select eight products in the supermarket and check prices per unit of product across several different sizes of packages (same brand). Are larger or smaller packages generally the better buy? Why do you think this is the case? Are they always the better buy?
2. If the supermarket sells some items in bulk, select two of those items. Compare the cost per unit of weight with the cost of the same item pre-packaged in the largest quantity available. (If more than one brand is sold pre-packaged, note the cost of two or three different brands per unit of weight.) Which is the best buy? Why? Which produces the least amount of after-use waste to dispose of?

The Meat Beat

At the meat counter in the supermarket, look at how meat is packaged. What happens to meat packaging materials after you are finished with them?

1. Try to find out how much is added to your bill because of the way meat is packaged.
2. Invent 10 ways to recycle meat packaging materials.
3. Try out at least two of your inventions, and write about your experiences with them.

Disposer Posers

Find at least three items sold in the supermarket that are designed to be disposed of after only one or a few uses.

1. To what extent is each item essential? Can you think of a nondisposable item a person could use instead of each disposable one?
2. Can any of the items you selected be refilled or otherwise reused many times?
3. How is each item disposed of? What happens to it then?

Activities for Extended Learning:

1. Answer the following questions about different formats for packaging beverages (e.g., cans, no-return bottles, returnable bottles). This may require writing or calling beverage packaging companies. Consider not only the type of container (e.g., bottle or can) but also the materials used to make it (glass, plastic, aluminum, other metals). NOTE: To get this information, you may have to call or write to beverage packaging companies.
   - Which format for packaging beverages uses the least amount of raw materials?
   - Which format uses the least water in processing?
   - Which format produces the least amount of water pollution?
   - Which format produces the least amount of air pollution?
2. Conduct an experiment with your own family's grocery shopping by going to the store with your parent(s). One week, shop for your entire week's groceries all at once. Another week, purchase your week's supplies in several visits to the store, made throughout the week, and purchase few enough items on each trip to take advantage of the fast check-out lanes. For each trip to the supermarket, keep track of how much time you spend on shopping, from the time you leave your home to the time you arrive back at home.
   - Which method of grocery shopping takes more time, altogether? Is there much difference between the time required by the two methods?
   - Which method of shopping uses fewer resources? Produces less air pollution?
   - Which method of shopping costs you less?

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STASH THE TRASH

Concepts:

- Current methods of solid waste disposal are inadequate to take care of all the trash, and all the different types of trash, we generate.
- The more people there are in the population, the more solid waste we are likely to generate.

Objective: Students construct a miniature sanitary landfill and identify advantages and disadvantages of disposing of solid waste in a sanitary landfill.

Subject Area: Science

Materials:

A large container, such as a glass jar or milk carton
Soil
A piece of fruit or vegetable, such as a slice of tomato or an apple core
A small piece of plastic, such as a plastic fork or part of a broken toy
A piece of newspaper or letter-quality paper
Optional: Pieces of fabric, styrofoam, aluminum foil, glass, grass or shrubbery clippings, chewing gum, cigarette butt, other items students select

Procedure:

1. Duplicate the student worksheet (master attached) and give each student a copy. Have students read the introduction on the worksheet.
2. Divide students into small groups. Provide the materials listed above to each group, or have each group's members divide among themselves the responsibility for bringing in items needed by their group.
3. Have students list materials they will be burying in their miniature sanitary landfills and estimate the extent to which each will decompose in one week, one month, three months and six months. Then have each group construct a miniature sanitary landfill, following the instructions on the student worksheet. (Alternatively, one miniature landfill may be constructed by the class as a whole.) Instruct students to keep the soil damp in the weeks and months that follow.
4. One week, one month, three months and six months after the miniature sanitary landfill(s) are constructed, have students observe the extent to which the items "disposed of" in their landfill(s) have changed or decomposed. Students should assess the accuracy of their initial estimates about how much each item would decompose over the different periods of time.
5. Have students discuss or write answers to the follow-up questions on their worksheets.

   Teacher's notes on answers:

   1) A material that lasts a long time before decomposing is more damaging to the environment than one which decomposes quickly.

   2) a) Approximately 1,278 pounds.
      b) Answers will vary according to the size of students' families.
      c) Answers will vary according to the size of students' families.

   3) a) 2,938,250,000 pounds.
      b) 1,469,125 tons.

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4) There are many possible answers to this question suggested in *Making a Difference*, included in this teaching kit. A few possible answers follow, along with the further discussion questions they suggest.

- More items can be recycled. (How can people be encouraged to recycle more of their trash?)
- Population growth can be limited, by voluntarily limiting family size and by limiting immigration. (How can people be encouraged to voluntarily limit the number of children they have?)
- Manufacturers and food packagers can reduce the amount of cellophane, cardboard, plastic, metal foil, and other packaging used to wrap many products. (How can they be encouraged to do this?)

5) Contact local solid waste management officials for these answers.

Follow-up Activities for Extended Learning:

1. Take a class field trip to an actual sanitary landfill. The sight (and smell) of a huge landscape full of garbage is a most impressive experience, and one which prompts many questions that can lead to further learning.
2. Have students create a not-so-miniature sanitary landfill on the school grounds, if possible. They can contribute trash of all kinds collected from school and home. Before disposing of it, they should sort it and catalogue it according to percentages of paper, plastic, wood, metal, glass, etc. As in the activity above, students should develop hypotheses about how much time the different kinds of materials will degrade in, say, three months and six months, and then compare their observations with their initial hypotheses.
3. Have students draw a map of your community showing sanitary landfills for garbage, hazardous waste dumps, and factories that generate hazardous wastes.
4. See activities on resource recycling in the "Waste Not, Want Not" module in this teaching kit.

The "Stash the Trash" miniature sanitary landfill activity and introduction on the student worksheet were adapted from *Earth Trek: Explore Your Environment*, U.S. Environmental Protection Agency, Washington, D.C. 20460, April 1987.

STASH THE TRASH
Student Worksheet

Introduction

People generate all kinds of solid waste: paper, aluminum cans, glass jars, plastic bottles, spoiled food, broken TV sets, old stoves, junk cars, and other trash and garbage that people throw away. Every year, the United States produces about 148 million tons of solid waste, about 3½ pounds per person per day! What should we do with all of it?

If we toss the stuff away carelessly, it litters streets, highways, the countryside, and waterways.

If we burn it in the open, it pollutes the air.

If we leave it in the open at garbage dumps, it smells, looks ugly, and attracts rats and insects.

If we bury it, we lose the value of materials in it that might be recycled (reused).

Open garbage dumps (where most of our solid waste goes) improve when they are turned into sanitary landfills. In a sanitary landfill, a layer of soil applied daily over the waste keeps pests away and keeps pollutants from washing off the site after the rain. The soil layer also prevents litter from blowing away and does away with the need to burn the waste.

To recycle solid waste and reclaim what is of value is an important goal. It is probably the best method of waste disposal because it allows materials to be used again. Otherwise, solid waste is really wasted solids.

There are many reasons why we don't recycle and recover more solid waste today. We don't know how to recycle some wastes, such as certain plastics. And it often seems easier and cheaper just to throw things away. But the cost of hauling, disposing of, and replacing throwaways is going up.

Some garbage that cannot be recycled or reclaimed now can be burned to produce energy. When burnable and non-burnable wastes are separated, the burnable waste can be mixed with coal and used as fuel in electric utility boilers.

One way to reduce the solid waste problem is to produce less solid waste. Do we really need all the cellophane, cardboard, colored paper, metal foil, and plastic bags that so many things come wrapped in?

Activity: Make a Miniature Sanitary Landfill

Objective:

Construct a miniature sanitary landfill and observe the extent to which different materials may be effectively disposed of in such a landfill.

Materials:

A large container, such as a glass jar or milk carton
Soil
A piece of fruit or vegetable, such as a slice of tomato or an apple core
A small piece of plastic, such as a plastic fork or part of a broken toy
A piece of newspaper or letter-quality paper
Optional: Pieces of fabric, styrofoam, aluminum foil, glass, grass or shrubbery clippings, chewing gum, cigarette butts, other items you select

Procedure:

Assemble the items to be "disposed of" in the miniature sanitary landfill you will construct and list them in your lab notebook. Some of these items will decompose, or break down and become part of the environment, while others will last a long time. Estimate the extent to which each item will decompose in one week, one month, three months and six months, and record your estimates next to the items on your list.

Place some soil in the bottom of the container. On top of the soil, place the fruit, plastic, paper and other items. Add more soil on top of them. Put the container in a warm place, and keep the soil damp. After one week, check to see what has happened to the items you buried in the soil. Does the fruit look different than it did when you buried it? Does the plastic look different? The paper? The other items? Note the changes you have observed in your lab notebook. How accurate were your estimates about the extent to which the items would decompose?

Check the materials again one month, three months and six months from the date you created the miniature landfill, and again note your observations in your lab notebook. How accurate were your estimates about decomposition over these time periods?

Continued on following page

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Follow-up Questions:

1. Which do you think is more harmful to the environment, a material that decomposes rapidly or one which lasts a long time before decomposing?
2. a) If each American produces about 3.5 pounds of solid waste per day, how many pounds does one person produce in a year?

   b) How much garbage does your family generate each day? Each year?

   c) If each family in the United States could only throw away 5,000 lbs. of trash per year, how much would each member of your family be able to throw away each year?
3. a) If the U.S. adds about 2,300,000 people a year, how many more pounds of garbage will the U.S. have to dispose of each year?

   b) How many tons of garbage is this? (There are 2,000 pounds in one ton.)
4. What are some things that can be done to solve the solid waste problem in the United States?
5. Find out about the solid waste management system in your local area. How is the trash disposed of? Is the existing system designed to handle the amount of solid waste the population is likely to generate over the next five years?

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WASTE NOT, WANT NOT

Concepts:

- Many of the items people typically throw away can be reused.
- Reusing items reduces the solid waste problem by reducing the demand for new items to be manufactured.

Objectives:

- Students identify ways to reduce the amount of solid waste produced by using fewer disposable items and reusing items that might otherwise be thrown away.
- Students promote recycling by other students and faculty and their families.

Subject Areas: Science, Social Studies

Introduction:

This unit includes three activities: (1) a school-wide event that promotes recycling while providing teachers and students with needed supplies; (2) a creativity exercise to identify ways commonly discarded household items might be productively reused; and (3) a no-waste party. It is suggested that the class do the "Creative Recycler" activity while they are gathering the materials needed for the school-wide recycling event. When the event is over, they can celebrate with the no-waste party.

Activity One: From Trash to School Supplies

Many household items routinely discarded in students' homes would be very useful to teachers and other students seeking low-cost supplies for classroom activities and school projects. Here is an event students can plan and carry out to both demonstrate the desirability of recycling and provide teachers and students with supplies they need.

On the other side of this page is a sample flyer, which can be adapted for your event. Share the list of items on the flyer with your students and ask if there are any additional "throwaway" items they believe teachers or students could use if they were made available in quantity. You might want to ask teachers this question too.

Ask students to begin saving items on this list that would otherwise be thrown away by their families. Large boxes or crates should be provided to serve as collection bins. Ideally, students should encourage the entire student body and faculty to contribute to the collection bins, and perhaps appeal to parents too through a newsletter, a flyer sent home with students, or a home-school association meeting. They should also encourage teachers and students to think about how they can use items from the list for their various projects.

On the day of the event, be sure all bins are clearly labeled and bags or boxes (recycled, of course) are provided for items taken by participants. Students should be on hand to assist participants in finding what they need. If you like, refreshments may be served as a further enticement to participate (using nondisposable supplies, if possible).

Activity Two: The Creative Recycler

1. Select one item from the list on the flyer and have the whole class brainstorm possible ways the item can be reused. Creativity is strongly encouraged; no suggestion is too absurd to be included during brainstorming! *After* the brainstorming session is finished, the class can go back over the list and eliminate suggestions that seem impractical.
2. Have each student (or pair or small group of students) select one or more items on the list and list creative ways the item or items might be recycled. If you prefer, assign this as a creative writing project, e.g., "My Memorable Year as a Yogurt Container." Students might also create illustrations of some of their suggestions to exhibit on a display at the recycling event. The students' suggestions, stories and illustrations may inspire teachers and other students to consider new ways they might use these "throwaway" materials.

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Activity Three: A No-Waste Party

Have the class plan a party or picnic that produces little or no waste. Challenge students to plan the event to use nondisposable or recyclable items for everything from decorations to refreshment supplies. Be sure the class takes responsibility for actually recycling or composting any items that might otherwise become waste.

This activity reinforces two ideas: (1) that things thrown "away" don't actually go away but do go somewhere, and (2) that students can exercise choice about the way they use resources.

Extended Learning:

Have students plan and carry out a Community Information Night to present to parents and others in the community what the class has been doing to reduce waste. It may be billed as an evening of community involvement, where refreshments are served and everyone has an opportunity to learn how they can contribute to a cleaner community. Students may display and describe their class projects and perhaps present (and/or hand out) a list of ways everyone can help reduce solid waste and protect the environment.

---------- [Sample flyer] ----------

ONE PERSON'S TRASH IS ANOTHER PERSON'S TREASURE!

Teachers, students: Come one, come all — to the recycling event of the year!

STASH THE TRASH NIGHT
October 18, 1989
Lafayette School Media Center

Collect valuable supplies for your school projects from our bins stocked with goodies rescued from the trash cans of students' and teachers' homes.

Student environmental education projects will be displayed, refreshments will be served, and everyone will receive a list of ways they personally can help solve our community's trash disposal problems.

Come for entertainment, involvement, and great supplies!

We will have bins full of the following items, all clean and ready to be used again for your school projects:

juice cans and their lids
plastic yogurt containers/lids
margarine tubs (and other plastic containers) and lids
coffee cans and lids
baby food jars and lids
35mm film canisters and lids
toilet paper rolls
paper towel rolls
egg cartons
tops of plastic milk bottles
paper bags—all sizes
plastic shopping bags
coffee scoops
6 oz. cat food/tuna cans
styrofoam meat trays
plastic lids
milk cartons
shoe boxes
small boxes with covers
magazines and catalogs with colorful pictures
popsicle sticks
newsprint paper
rubber bands
wood scraps
wallpaper scraps
fabric scraps
buttons
socks (unmatched okay)
mittens (unmatched okay)
plastic forks, knives, spoons
ribbon, yarn, string
unused stickers and stamps
crayons (broken okay)
corks
bottle caps
hangers
shirts that button down the front
styrofoam packing materials
rug scraps
cardboard oatmeal boxes
clay or plastic flowerpots
aluminum pie plates
plastic trays from microwaveable prepared foods
aluminum trays from frozen dinners

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WORLD REAL ESTATE

Concept: The size of any population, including the human population, must have an upper limit, as there is only a finite amount of essential resources to support the population.

Objectives:

- Students observe a demonstration of world land use and determine approximately how much of the Earth's surface is land used to grow food crops.
- Students estimate the amounts of land required to support several types of animals.
- Students calculate how much land there is for each person on Earth, given different population sizes, and what types of habitat make up the land.

Subject Areas: Science, Math, Social Studies

Introduction:

Every environment has a carrying capacity — the point at which it can no longer support additional members of a species with the natural resources they need to survive. When asked to determine how much land a human being needs for survival, students may think only in terms of their living space. They often do not realize how much land is needed to provide them with food, fuel, shelter and textiles for clothing.

Activity 1 below is a demonstration that makes an excellent opener for a lesson on carrying capacity. Activity 2 presents students with a number of problem-solving challenges related to world land use.

Activity One: Earth: The Apple of Our Eye*

Materials:

Large apple
Kitchen knife

Procedure:

1. Tell students to think of the Earth as an apple. Slice an apple into quarters and set aside three of the quarters. Ask, "What do these represent?" (The oceans of the world.) The fourth quarter roughly represents the total land area of the world.
2. Slice this "land" in half. Set aside one of the pieces. The portion set aside represents the land area that is inhospitable to people: the polar areas, deserts, swamps, very high or rocky mountains. Ask, "What fraction do we have left?" (1/8.) The piece that is left is land where people live, but not necessarily grow the foods needed for life.
3. Slice the 1/8 piece into four sections and set aside three of these. Ask, "What fraction do we have left?" (1/32.) The 3/32 set aside represent the areas too rocky, too wet, too cold, too steep, or with too poor soil to actually produce food. They also contain the cities, suburban sprawl, highways, shopping centers, schools, parks, factories, parking lots and other places where people live, but not necessarily grow food.
4. Carefully peel the 1/32 slice of Earth. This tiny bit of peeling represents the surface, the very thin skin of the Earth's crust upon which mankind depends. It is less than five feet deep and is a quite fixed amount of food-producing land.
5. Explain that protecting our land resources is very important. Advanced agricultural technology has enabled the world to feed many of its people. But, with a fixed land resource base and an ever-increasing number of people to feed from that fixed base, each person's portion becomes smaller and smaller. It is essential to protect the environmental quality of our air, water and land.

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Activity Two: Shares of Mother Earth**

Materials:

Student worksheets (one per student)
Pen or pencil
Calculator (optional)

Introduction:

Carrying capacity for each animal species depends upon the amount of natural resources available on a given area of land. For example, to raise one cow, you would need one acre (about the size of a football field) of very rich pasture land, or ten acres of range land, or 100 acres of scrub land.

Procedure:

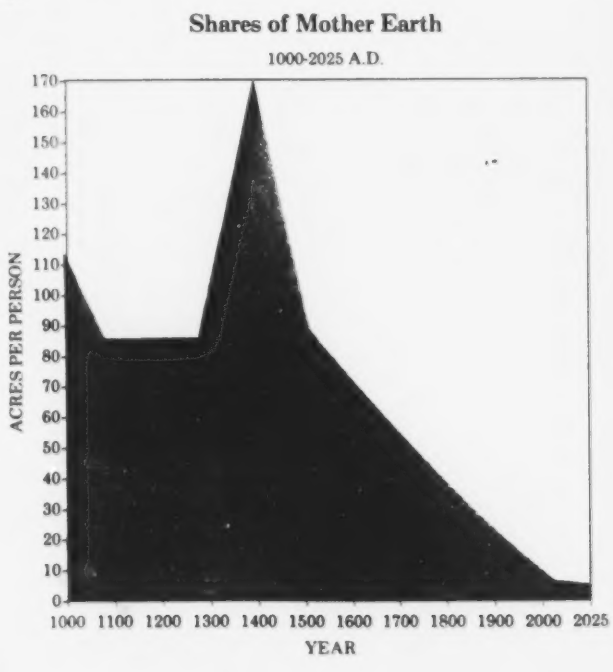
Duplicate the student worksheet at the end of this activity so that there are enough for each student to have one. Then have students complete the exercises on the worksheet, working individually or in small groups. Follow up with the activity, "Global Warming Begins at Home," done as a class. Then lead a class discussion guided by the following questions:

Answers to student worksheet questions:

1. All student estimates should be allowed, no matter how farfetched. For the sake of class discussion, the actual amounts of land needed for the animals listed are as follows:
   A. 1 acre
   B. 1.2 acres
   C. 32,000 acres, or 50 square miles
   D. 38,400 acres (60 square miles) if it is male or
      3,200—12,800 acres (5-20 square miles) if it is female
   E. 8,000 pounds of fish (in a pond 40 feet deep at the center)
   F. There is no one right answer to this question, since different life styles would determine how much land a human requires. A wealthy, American celebrity may require millions of acres to gratify his/her desire for fine clothes, food and homes, while a resident of a poor, African village may only require two or three acres of land. According to Dr. Edward Passerini of the University of Alabama, 2.5 acres would be about the minimum amount of land that a human would need to survive.
2. A. Student estimate
   B. How many people there are and how many acres of land there are on Earth
   C. 6.8 acres
   D. It will get smaller
3. 2.04 acres of forest
   1.7 acres of meadow
   2.04 acres of wasteland
   0.82 acres of farmland
   0.2 acres of pond or swamp
4.

Year	Number of People (in billions)	Acres/Person (Rounded to nearest whole number)
1000	0.3	113
1100	0.4	85
1200	0.4	85
1300	0.4	85
1400	0.2	170
1500	0.4	85
1600	0.5	68
1700	0.7	49
1800	1.0	34
1900	1.6	21
2000	6.3	5
2025	8.5	4

5.



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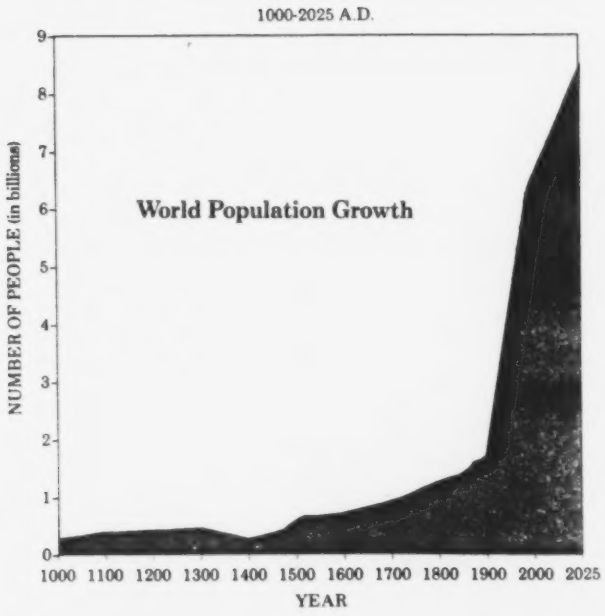

Bonus question: 93,600,000 people (93.6 million)

Discussion questions for extended learning:

1. How do you explain the dip in population between 1300 and 1500? What are some possible explanations for the sharp increase in population from 1800 to the present?
2. How do you think the quality of life will change by additional increases in human population? How might it get better? How might it get worse?
3. As we use more and more land for the needs of people, what will happen to the animals and plants that are now living on the land? Why?

*Developed by Audrey Brainard, Science Consultant, Holmdel, NJ.

**Adapted with permission from Mike Weatherby, Kilo Junior High School, Federal Way, WA.

WORLD REAL ESTATE
Student Worksheet

1. How many acres of land do you think each of the animals below would require to accommodate all its needs for an entire life span? The acres could be jungle, grassland, pond, or whatever your animal required. Remember, an acre is about the size of a football field and they must get all of their needs from their habitat.
   - A. A cottontail rabbit needs _____ acres of land for a lifetime.
   - B. A chipmunk needs _____ acres of land for a lifetime.
   - C. An African elephant needs _____ acres of land.
   - D. A black bear needs _____ acres of forest land.
   - E. You could raise _____ lbs. of fish in one acre of a deep pond.
   - F. A human being needs _____ acres of land.
2. A. If we divided the entire land area of the world up into acres and gave every person on Earth an equal share of acres, how many acres do you think your fair share of land would be? _____.
   - B. To determine the actual amount, what would you need to know?

     _____

     _____.
   - C. If there are about 5 billion people on earth and the Earth contains about 34 billion acres of land, what is your fair share of land? _____ acres.
   - D. What will happen to your fair share of Earth if the world's population continues to grow? _____.

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3. Now that you know how much land you have, you also need to know what type of land it is. You can figure out how much of your land is forest, meadow, wasteland, farmland or pond by multiplying the decimal amount times your total acres. (For example: To determine how much farmland you have, multiply 0.12 times your total share of land.)

   If 30% of your land is forest, _____ acres are forest.
   If 25% of your land is meadow, _____ acres are meadow.
   If 30% of your land is wasteland, _____ acres are wasteland.
   If 12% of your land is farmland, _____ acres are farmland.
   If 3% of your land is pond or swamp, _____ acres are pond or swamp.

4. Find out how many acres of land people had in the past and how many acres people will have in the future for the following years. Remember, divide billions of people into 34 billion acres of land.

Year	Billions of People	Acres/Person
1000	0.3	_____
1100	0.4	_____
1200	0.4	_____
1300	0.4	_____
1400	0.2	_____
1500	0.4	_____
1600	0.5	_____
1700	0.7	_____
1800	1.0	_____
1900	1.6	_____
2000	6.3	_____
2025	8.5	_____

5. Obtain two pieces of graph paper from your teacher. On one, graph population growth for each of the years listed above. On the other, graph land per capita for each of those same years. For comparison, make both graphs about the same size.

Bonus Question:

If the world's population of 5.2 billion is growing by 1.8%, how many additional people will there be after one year? _____.

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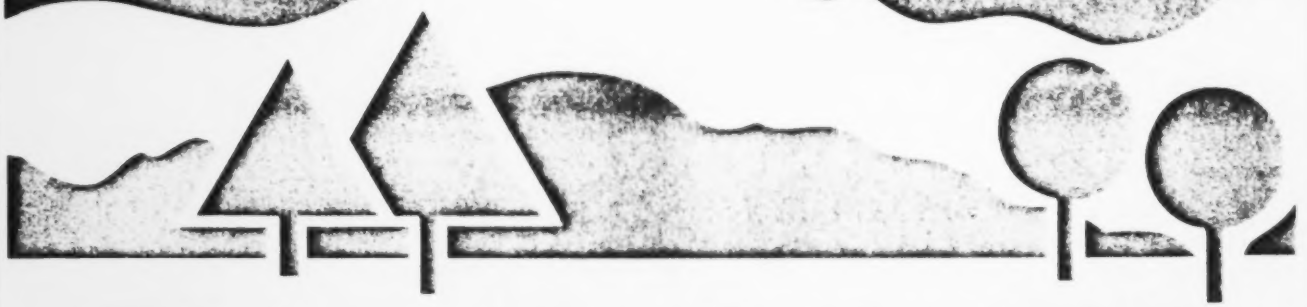
FOR EARTH'S SAKE

LESSONS IN POPULATION AND THE ENVIRONMENT



TEACHER'S GUIDE

ABOUT THIS KIT: WHAT'S IN IT...HOW TO USE IT

For Earth's Sake: Lessons in Population and the Environment is a middle school teaching kit to introduce young people to the remarkable interconnectedness of people and the environment. It is designed to give students an understanding of important population and environmental concepts while promoting a sense of individual responsibility for stewardship of the Earth.

The teaching modules in this kit touch on issues as immediate as traffic congestion and garbage disposal and as far-reaching as global warming and inequitable resource distribution. The activities are interdisciplinary, developing knowledge and skills applicable to science, math and social studies. While they are designed primarily for use in grades 6-8, many activities are appropriate for grades 9 and 10 as well.

CONTENTS OF THE KIT:

- *Meeting the Population Challenge* — a master to be duplicated so that all students may read basic background information on population growth and its environmental impacts before participating in the hands-on classroom activities. It includes a glossary for easy reference.
- *17 hands-on activity modules* which may be used individually or may be combined to present a larger unit.
- *Making a Difference* — a list of 150 concrete suggestions of things individuals can do in their homes, schools and communities toward a sustainable balance of population, resources and environment.
- *Population Education Resources* — a comprehensive listing of further information sources related to population and the environment, including books, bulletins, software, films and other teaching materials.
- *World Population Data Sheet* — a useful chart, produced annually by the Population Reference Bureau, which provides demographic data for every country.

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HOW TO USE THE KIT:

We suggest that teachers first assign the student reading material, *Meeting The Population Challenge*, and discuss it in class. Then introduce some of the hands-on activities to further reinforce students' understanding of the concepts presented, while developing critical thinking and problem-solving skills.

The activities in this kit are intended to be both fun and thought-provoking. Most use a hands-on approach to make abstract concepts more concrete and to motivate students to participate actively in the learning process.

Many activities lend themselves to cooperative learning techniques in which students share ideas as they work out problems in a group. In such groups, students can learn from each other and develop cooperation skills that will help prepare them for interaction in the school, workplace, family and in an increasingly interdependent world.

Because it is important to leave young people with a sense that something *can* be done about global environmental problems, the kit includes a list of 150 ways each individual can help in *Making a Difference*. It is hoped that the students who study the important population and environmental issues as young people will remember these lessons as they get older and take on the responsibility of decision making as parents, voters and leaders.

* * *

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ACTIVITIES

BURSTING WITH GROWTH
Curriculum Areas: Social Studies, Science
Concepts: Carrying capacity, land use
Skills: Decision making, graphing

COUGAR HUNT
Curriculum Areas: Science, Math
Concepts: Carrying capacity, interdependence in nature
Skills: Analysis of population dynamics and ecological interdependence

DRIVING TO THE LIMIT
Curriculum Areas: Math, Social Studies, Science
Concepts: Traffic congestion, air pollution, land use, energy use
Skills: Arithmetic with large numbers, calculating percentages, word problems, metric conversions, making and reading maps, observation,

EVERYTHING IS CONNECTED
Curriculum Areas: Science, Social Studies
Concepts: Interdependence in nature and society
Skills: Analysis of ecological and social interdependence

FAMILY PERSPECTIVE
Curriculum Areas: Science, Math, Social Studies, Home Economics, Family Life
Concepts: Family-size trends, family size decision making
Skills: Calculating averages, decision making

FOR THE COMMON GOOD
Curriculum Areas: Social Studies, Science
Concepts: Resource distribution, resource conservation, cooperation
Skills: Decision making, cooperation

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HUMAN MASSES, GREENHOUSE GASES
Curriculum Areas: Science, Math
Concepts: Air pollution, global warming, importance of forests
Skills: Arithmetic with large numbers, word problems

LOOKING TO THE FUTURE
Curriculum Areas: Science, Social Studies, Language Arts, Family Life
Concepts: Life planning, futuristic projections, population and environmental trends
Skills: Values clarification, making educated projections, imagination, reading and summarizing news articles

MEASURING A MILLION
Curriculum Areas: Math, Science
Concept: Size of large numbers
Skills: Measuring, arithmetic, map reading, cooperation

NEEDS VS. WANTS
Curriculum Areas: Science, Social Studies
Concepts: Resource distribution, resource consumption
Skills: Resource analysis, values clarification

ON THE DOUBLE
Curriculum Areas: Math, Science, Social Studies
Concepts: Population growth rates, doubling times
Skills: Chart reading, data interpretation, calculating percentages, arithmetic with decimals

POPULATION CIRCLE
Curriculum Areas: Math, Science, Social Studies
Concept: Exponential growth vs. arithmetic growth
Skills: Distinguishing exponential growth from arithmetic growth

SHARE THE WEALTH
Curriculum Areas: Social Studies, Science
Concepts: Resource distribution, global interdependence
Skills: Decision making, cooperation

SHOPPERS' CHOICES, CONSUMERS' VOICES
Curriculum Areas: Science, Math, Social Studies
Concepts: Decision making, resource conservation, solid waste generation and reduction
Skills: Observation, cost comparison, arithmetic, decision making, research

STASH THE TRASH
Curriculum Areas: Science
Concepts: Solid waste generation and reduction
Skills: Hypothesis, observation

WASTE NOT, WANT NOT
Curriculum Areas: Science, Social Studies
Concepts: Solid waste generation and reduction
Skills: Creativity, organizing a school-wide initiative, conservation, educating others

WORLD REAL ESTATE
Curriculum Areas: Science, Math, Social Studies
Concepts: Carrying capacity, land use
Skills: Arithmetic, calculation of percentages, graphing

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ACTIVITIES GROUPED BY TOPIC

Consult alphabetical listing of activities for specific concepts and skills covered by these activities.

Carrying Capacity
Bursting with Growth
Cougar Hunt
World Real Estate

Energy Use/Air Pollution/Global Warming
Driving to the Limit
Human Masses, Greenhouse Gases
Needs vs. Wants

Interdependence in Nature
Cougar Hunt
Everything Is Connected

Population Concepts and Trends
Family Perspective
Looking to the Future
Measuring a Million
On the Double
Population Circle

Resource Distribution
For the Common Good
Needs vs. Wants
Share the Wealth

Responsible Citizenship in an Interdependent World
Bursting with Growth
Everything is Connected
For the Common Good
Needs vs. Wants
Share the Wealth
Shoppers' Choices, Consumers' Voices

Solid Waste Generation and Reduction
Stash the Trash
Shoppers' Choices, Consumers' Voices
Waste Not, Want Not

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